Am. B. 3040

Proceedings

54TH CONGRESS, 1st Session. } HOUSE OF REPRESENTATIVES. { DOCUMENT No. 2.

REPORT

OF THE

SECRETARY OF WAR;

BEING PART OF

THE MESSAGE AND DOCUMENTS

COMMUNICATED TO THE

TWO HOUSES OF CONGRESS

AT THE

BEGINNING OF THE FIRST SESSION OF THE FIFTY-FOURTH CONGRESS.

IN THREE VOLUMES.

VOLUME II—IN SEVEN PARTS.

PART 7.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1895.

BIBLIOTHECA
REGIA
MONACENSIS

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ANNUAL REPORT OF THE MISSOURI RIVER COMMISSION FOR THE FISCAL YEAR ENDING JUNE 30, 1895.

OFFICE MISSOURI RIVER COMMISSION,
St. Louis, Mo., June 30, 1895.

SIR: The Missouri River Commission beg leave to submit herewith their annual report for the fiscal year ending June 30, 1895.

APPROPRIATIONS AND ALLOTMENTS.

The sundry civil bill of August 18, 1894, and the river and harbor bill of August 17, 1894, contained the following items of appropriation:

Under Missouri River Commission: For improving Missouri River from its mouth to the south line of Sioux City, Iowa, including salaries, clerical, office, traveling, and miscellaneous expenses of the Missouri River Commission, surveys, permanent bench marks and gauges, seven hundred and fifty thousand dollars, fifty thousand dollars of which may be used for removal of snags and other like obstructions in the Missouri River above Sioux City, Iowa, from the south line thereof, to be expended under the direction of the Secretary of War.

Missouri River, from its mouth to the lower limits of Sioux City, Iowa: The Missouri River Commission is authorized and directed to expend from the appropriations for the improvement of said river seventy-five thousand dollars in the rectification of the river at Omaha, Nebraska; thirty-five thousand dollars at Atchison, Kansas; and fifty thousand dollars at St. Joseph and other localities on the river in the State of Missouri where the Commission may deem such improvement necessary.

Improving Gasconade River, Missouri: Continuing improvement, five thousand dollars; and improving Osage River, Missouri: Continuing improvement, forty-six thousand dollars, to be expended by the Missouri River Commission.

The sums thus appropriated, of which $751,000 was available for work under the Commission, were allotted as follows:

IMPROVING MISSOURI RIVER FROM MOUTH TO SIOUX CITY, IOWA.

[Act of August 18, 1894, as modified by act of August 17, 1894.]

For systematic improvement in first reach	$450,000
For operating snag boat	40,000
For office and traveling expenses and salaries of Commission	20,000
For surveys, gauges, physical data, and publications	30,000
For rectification of the river at Omaha, Nebr. (specific appropriation)	75,000
For rectification of the river at Atchison, Kans. (specific appropriation)	35,000
For rectification of the river at St. Joseph, Mo	22,000
For rectification of the river at Leavenworth, Kans	28,000

IMPROVING OSAGE RIVER, MISSOURI AND KANSAS.

[Act of August 17, 1894.]

For construction of lock and accessories	$44,200
For snagging operations	1,000
For examination of the stream	800

IMPROVING GASCONADE RIVER, MISSOURI.

[Act of August 17, 1894.]

Removal of snags and other obstructions, etc	$4,500
Examination of the stream from mouth to Arlington	500

SURVEYS AND EXAMINATIONS.

Topographical survey.—A party was organized, and assembled at Jefferson City, Mo., October 20, 1894, for the purpose of beginning a complete topographical survey of the Missouri River Valley between Sioux City, Iowa, and the mouth of the river, a distance of 806 miles.

The survey is intended to cover thoroughly all of the valley within about 1½ miles of the river, except where the bluffs approach nearer, and to locate the line of the bluffs in all cases, even where this line is several miles away from the river; the low ground to be contoured at 5-foot intervals, the bluffs at 20-foot intervals; the party to be subsisted on a quarter boat, which is to be floated downstream as the work progresses.

The work was begun near Jefferson City on account of the shortness of the remaining working season and the desirability of having the season's work end near one of the Commission's boat yards, where the party's quarter boat and outfit might be cared for during the winter.

The party was placed in charge of Assistant Engineer C. M. Winchell, whose appended report (Appendix D) gives the details of the season's work. The work extended from the head of Stanley Island to secondary triangulation station "Fey," 1 mile below the mouth of the Gasconade River, or a river distance of 54 miles, and was closed on December 19.

During the winter and spring the results of the above survey were platted on three large detail maps (scale, 1 inch=1,000 feet).

Assistant Winchell and party again took the field May 21, 1895, to continue this survey, and at the close of the fiscal year had reached Fiddle Creek, Missouri, 47 miles (river distance) below station "Fey."

It is proposed during the current season to continue this survey to the mouth of the river; then to tow the quarter boat and party to a point at such distance above Stanley Island as can be covered during the remainder of the working season. In this way the party will close their season's work only 18 miles above the Ewing boat yard, where the boat and outfit can be cared for during the winter.

Mapping.—The series of maps of the Missouri River, survey of 1889–1893, extending from its mouth to Three Forks, Mont., intended for photolithography, has been completed. The series comprises 84 inch-mile maps (Nos. 1–83 and an additional map, No. 28*a*, found to be necessary to show topography outside the limits of Nos. 28, 29, and 30) and 9 index maps, geographically projected from published data of the Commission's secondary triangulation. A title page and table of distances and of conventional signs are yet to be prepared.

Of the above maps, inch-mile maps Nos. 28–38 and No. 28*a*, covering a river distance of 311 miles, and index maps Nos. 4 and 5 have been completed within the fiscal year.

Printed editions of inch-mile maps Nos. 31–53, 55, and 57–60 and of index maps Nos. 6–8 have been received during the year. Proofs of inch-mile maps Nos. 29 and 30 have been received, corrected, and returned for printing.

The comparative map referred to in the last annual report of the secretary of the Commission, on which are to be platted, one above another, the results of annual surveys of the Jefferson City reach from Claysville to Isbell, is completed for the years 1890, 1891, 1892, and 1893.

Considerable miscellaneous mapping work in addition to the above has been done.

All mapping work has been under supervision of Assistant Engineer O. B. Wheeler.

Levels.—The list and descriptions of all the Commission's bench marks from the mouth to Sioux City, Iowa, and from Fort Benton, Mont., to Three Forks, Mont., referred to in the last annual report of the secretary of the Commission, has been completed for publication.

A profile chart showing discrepancies between the Commission's direct and reverse precise level line of 1892 between St. Joseph, Mo., and Sioux City, Iowa, has been prepared.

Special surveys.—Special surveys or examinations at Omaha, Nebr., St. Joseph, Mo., Atchison, Kans., Leavenworth, Kans., Kansas City, Mo., and Arrow Rock, Mo., are noted under "Construction."

In March, 1895, a survey was made by Assistant Engineer O. H. B. Turner to locate and determine the effect of certain obstructions, consisting of remains of false work, under the railroad bridge at Glasgow, Mo.

An examination of the Gasconade River is in progress. (See report on that river.)

The following special surveys were made under the direction of the division engineers during the year:

Head of Stanley Island, Missouri, to foot of St. Aubert Bend.
Mouth of the Auxvasse River, Missouri, to foot of Chamois Bend.
Site of proposed bridge at Jefferson City, Mo. (two surveys).

In addition to the above, special surveys to ascertain changes in channel and shore lines, due to works of improvement, were made, and the regular sounding on the established ranges in the reaches under improvement was kept up.

Gauges and physical data.—Twenty-three permanent gauges have been maintained on the Missouri River throughout the year. All these have been read twice daily, and the readings forwarded weekly to this office. The gauges, with the exception of that at De Witt, Mo., have been maintained in fair condition by the observers. At De Witt the gauge was partially destroyed in January, 1895, by the Wabash Railway Company in revetting the bank at the location of the gauge, and temporary gauges have had to be used for low-water readings. A new gauge will shortly be erected at this point. At Brownville, Nebr., due to a radical change in the channel, the water at low stages is at some distance from the gauge, and temporary gauges on bars have been used at such times.

Two temporary gauges have also been maintained throughout the year by Division Engineers Yonge and Fox in connection with the improvement work in first reach. The readings of these gauges have been sent regularly to this office. Through the courtesy of Capt. H. F. Hodges, Corps of Engineers, readings have also been received weekly throughout the year from the gauges at Fort Benton, Mont., and Bismarck, N. Dak.; and, for a portion of the year, from those at Wolf Point, Mont., Fort Buford, N. Dak., and Running Water, S. Dak.

Only one tour of gauge inspection has been made during the year, it having been impossible to spare the services of an assistant engineer for more frequent tours; but it is proposed to send out an assistant on an inspection tour soon.

The pilot bulletin service, exhibiting the daily stage of the river at all the Commission's gauges from Kansas City to the mouth, was discontinued for the winter at all points except Kansas City on November 30, 1894, and was resumed April 1, 1895. At Kansas City, at the request of local steamboat men, it was continued until January 11, 1895, and was resumed forty-two days afterwards, ice having prevented river traffic in the meantime.

The manuscript of a pamphlet of Missouri River stages for the years 1890–1894 has been prepared for publication.

Final hydrographs for the years 1890–1894 have been completed.

On the Osage River, the four gauges formerly maintained by Maj. Charles J. Allen, Corps of Engineers, have, since January 15, 1895, been maintained by the Commission, the system of reporting the readings being modified to conform with the system in use on the Missouri.

Full details of the year's gauge work will be found in the report of Assistant Engineer A. H. Blaisdell. (Appendix E.)

Assistant Engineer J. A. Seddon has continued the study of regimen, as outlined in his last annual report, and, for the reasons there stated, this study has been mainly followed in data of the Lower Mississippi, where it is furnishing the means of reaching some definite conclusions.

CONSTRUCTION.

Special surveys or examinations on which to base projects for the expenditure of the appropriations made by act of August 17, 1894, for work at Omaha, Atchison, and St. Joseph and other localities in Missouri, were made by Assistant Engineer J. C. Meredith in October and November, 1894, at Omaha, Nebr., St. Joseph, Mo., Atchison, Kans., Leavenworth, Kans., Kansas City, Mo., and Arrow Rock, Mo.

The Commission decided to recommend the allotment, from the $50,000 appropriated for work at St. Joseph and other localities in Missouri, of $22,000 for work at St. Joseph and of $28,000 for work on the Missouri side of the river near Leavenworth; and their projects for work at these points, with those for work at Omaha and Atchison, received the approval of the Secretary of War December 27, 1894.

It was decided to place these works under the direction of the secretary of the Commission and in local charge of a division engineer, whose office should be established at Council Bluffs, Iowa. Assistant Meredith was chosen for this position. The office at Council Bluffs was opened in February, 1895.

Omaha, Nebr.—The approved project provides for repairing the Council Bluffs revetment, and for masking, by a system of permeable dikes, the "pocket" that had been formed in the bank line just above the Interstate Bridge. This pocket, by interrupting the regularity of curve of the bend, produced a varying and unfavorable approach to the bridge. The dikes provided for are a longitudinal dike, 2,600 feet long, with a shore arm at the upper end, three interior cross dikes connecting the longitudinal dike with the shore, and three independent cross dikes below the longitudinal dike and extending out to the line of this dike prolonged.

The repair of the revetment was completed April 1, 1894.

Bids were opened February 21, 1895, for the principal items of material needed for the dike work, and contracts made with the lowest reliable bidders. All of the material was to have been delivered by June 30, 1895; but the contractor for lumber and piling has failed to complete delivery within the time specified. This has greatly delayed the construction of the dikes.

Work has been done on the upper portion of the longitudinal dike, on the three interior cross dikes, and on two of the independent cross dikes. A full description of the work done and plant employed is given in the appended report of Division Engineer Meredith. (Appendix F.)

St. Joseph, Mo.—The approved project contemplated the complete repair of the revetment in Bon Ton and Belmont bends.

The examination of October, 1894, showed that there then existed several breaks in each of these revetments, aggregating about 1,430 feet in length in Bon Ton Bend and about 325 feet in Belmont Bend, which latter amount and about 930 feet of the Bon Ton breaks consisted only in the destruction of the grade and the removal of rock forming the upper bank protection.

Work was carried on, with some interruptions, from March 16 to May 11, at which time the repair of the above breaks had been completed. An inspection of the work shortly after indicated the necessity of repairing a break that had lately developed at the lower end of the Belmont revetment. The repair of this break having been completed May 22, the force was disbanded and the local office closed.

A surplus of about 1,100 cubic yards of rock, distributed along these revetments, remains available for future small repairs.

Full details of the work done will be found in the appended report of Division Engineer Meredith. (Appendix G.)

Atchison, Kans.—The formation of a cut-off opposite Doniphan in July, 1891, has given rise to excessive slopes and a very unstable regimen in this reach for a considerable distance below and above the cut-off. Great erosion has occurred in the reach, resulting in the washing away of about two-thirds of the high ground of Atchison Island and the formation of a bend in the left bank above Atchison, with the destruction of the former railroad approaches from the north to the Atchison Bridge. Nearly all the dikes that formerly protected this portion of the left bank have been flanked and destroyed, and the moving down of the bend threatened the east approaches of the bridge. The complete erosion of Atchison Island will, it is thought, cause the channel to leave the east bank and follow the bluffs on the Atchison side, giving a favorable approach to the bridge and relieving the threatened interests on the east bank.

The approved project provides for attempting to hold the east end of the bridge until Atchison Island can wear away; $20,000 to be expended in strengthening the present revetment just above the bridge, and in extending it as far upstream as the funds will permit; and $15,000 to be reserved for use in an active defense at high water or at other times when needed.

During 1894 and in January, 1895, considerable work had been done by the railroad companies whose property was endangered and by the bridge company in endeavoring to prevent further erosion in the bend. The bridge company having requested that the further funds which they intended to devote to bank protection might be expended jointly with the funds appropriated by Congress, arrangements were made with Mr. N. D. Todd, receiver of the company, whereby the latter should furnish without cost to the United States the brush and stone required for the proposed revetment. By this arrangement the funds available permitted the construction of 6,302 linear feet of mattress from 100 to 120 feet in width, with a mattress header 150 feet in width and extending back 100 feet from the bank. During the present month the erosion just above the head of the mattress has necessitated the further extension of this mattress header inland for a distance of 200 feet.

The work of revetment construction began February 5, and, with the exception of the above-mentioned work done in June, was completed April 10.

From February 5 to 28 mattress weaving was done on the ice. This method of working, though somewhat experimental and hazardous, proved very successful. It was found that mattresses could be woven

in this way much more rapidly than by the use of floating plant, and all the mattress constructed on the ice was sunk without loss.

The balance remaining to the credit of this appropriation it is proposed to devote to defense of the revetment when required.

No great rise of the river having occurred this year at Atchison, as large an amount of erosion at Atchison Island as was hoped for has not taken place.

Full details of the work done are given in the appended report of Assistant Engineer Meredith. (Appendix H.)

Leavenworth, Kans.—The bifurcation of the channel below the Fort Leavenworth Bridge threatened the east approach of the new bridge at Leavenworth. To protect this approach the bridge company have constructed a curved dike extending from the east abutment of the bridge to the main left bank above. Considerable scour occurred at every high water along this dike, particularly at the salient, necessitating large expense for maintenance.

The approved project provides for the construction of two dikes extending out from the east shore below the Fort Leavenworth Bridge and above the head of the middle ground, so as to reduce the amount of water passing through the east chute, and thereby relieve the danger to the east approach of the Leavenworth Bridge and produce a more favorable approach of the river to this bridge.

Bids were opened February 21, 1895, for the principal items of material needed for the dike work, and contracts made with the lowest reliable bidders. All of the material was to have been delivered by June 30, 1895.

The contractor for the lumber and piling needed has failed to complete the delivery of these materials within the time specified. This has greatly delayed the dike construction.

Work on the dikes began May 8, and has continued to date. The upper dike is completed and the lower dike about one-half completed.

Full details of the work done and plant used will be found in the appended report of Division Engineer Meredith. (Appendix I.)

SYSTEMATIC IMPROVEMENT OF FIRST REACH.

The first reach of the Missouri River improvement extends from the mouth of the Osage River to the mouth of the Missouri, a distance of 141 miles. Upon this portion of the river, and in accordance with the instructions of Congress, the Commision is engaged in carrying out a systematic and continuous improvement of the river for purposes of navigation. Owing to the lack of a proper heading for the work at the mouth of the Osage, it has been necessary to go some 14 miles farther upstream, to the head of Murrays Bend, to initiate the work. The shore of this bend has been revetted to prevent any further movement downstream of the channel. Starting from the foot of the bend, the river, by suitable contraction works, is held against the right-hand bluffs at and below Jefferson City as far as the upper mouth of the Osage River, a distance of 12 miles. From this point it is led between a double system of contraction works through the shoals outside of Dodds Island to a contact with the detached bluff at Côte Sans Dessein, and thence by the same means to a contact with the right-hand bluffs near Isbell Station, 7 miles below Osage Point. Thence for a distance of 3 miles the river follows these bluffs. The crossing into St. Aubert Bend is controlled by a group of dikes to be constructed opposite the head of this bend, and the river will then be led along the revetted

bank of this bend, and also of St. Aubert Island, till it returns to the right bank in Chamois Bend. The bank of this bend is revetted and a group of dikes near the head directs and holds the river against this revetted bank. From Chamois Bend the river crosses to Portland and is thence held against the rocky left-hand shore by a series of dikes on the other side of the river. Finally, near Bluffton it is again diverted to the right bank, where it will impinge against a revetted shore line in Straubs Bend and follow this shore to the mouth of the Gasconade. The total distance thus covered is 45 miles. Work has been in progress along the whole extent of it, and will, so far as now appears, be nearly completed by the end of the coming fiscal year.

Owing to the exhaustion of the appropriation of 1893 and the late date at which the appropriation of 1894 became available, but little work was done last season, but as soon as the river opened in the spring work was resumed and was vigorously prosecuted to the close of the fiscal year. For convenience of administration the work is divided into the Osage division, in charge of Assistant Engineer S. H. Yonge, and the Gasconade division, in charge of Assistant Engineer S. W. Fox. The Osage division includes all work from the head of Murrays Bend to St. Aubert Bend, the Gasconade division all work from this point to the Gasconade River. All work on the first reach is under the immediate charge of the president of the Commission.

OSAGE DIVISION.

Murrays Bend revetment.—This revetment has needed some slight repairs during the year, mainly to the stone paving of the upper bank, which in some places showed a tendency to sink under wave and eddy action.

Cedar City dikes.—The upper dike of this system was never entirely completed. Two gaps of 125 feet and 80 feet, respectively, which had been inaccessible during the process of construction and since, were closed by a fence of posts and wire cable covered with wire netting. During the coming season it is proposed to extend these dikes slightly and strengthen their outer ends, to build two short dikes between them, and to build a long oblique dike (E) to more effectually close the channel which formerly existed along the left bank.

Dikes P and Q.—This group of dikes, situated nearly opposite the mouth of Boggs Creek, was intended to cut off a channel which followed the left bank from Cedar City to Harlands Island, and to force the whole river along the right-hand bluffs. These dikes were never completed. Their extension to the full length contemplated is part of the project of this year.

Dikes 1, 2, 3, 9, 10, and 11 (near Ewings Landing).—Dike 3 was extended 169 feet during the year, and small extensions of the other dikes of the system are contemplated for this season, as well as the revetment of the towhead opposite Ewings Landing.

Dikes 13, 13 A, 13 B, and 14, in front of Harlans Island, require slight extensions, which will be made this year.

Dikes 17 B and 17 C are two short dikes on the right bank above Dike 17 A, and which it is proposed to construct this season to lessen the strain on Dike 17 A.

Below these dikes Osage Chute leads off to the right and joins the Osage River, of which at certain stages it forms the mouth. The Commission have not deemed it necessary to close this chute by a high dam, but have sought to divert the flow of the Missouri to the north of Dodds Island by the system of Dikes 17 A, 18 A, and 19 A along the

end of the right-hand bluff. This object was only partly accomplished, and to cut off the low-water flow into Osage Chute a dam was built in the fall of 1893 extending across it from Osage Point to the head of Dodds Island. This dam has answered its purpose very well, but the eastern portion nearest the island has been undermined several times and has required repairs to keep it up to the proper level. This portion of the dike is of much smaller section than the rest, having been originally built on a sand bar dry at low water. More or less action of this kind is to be anticipated until the section more nearly equals that of other parts of the dam. The channel into the chute, which formerly followed the line of the bluff, is now deflected far to the east by the group of dikes before alluded to, and around the end of which it turns sharply. The outer end of Dike 19 A was undermined and carried away by this action in 1894 and had to be rebuilt this spring. In order to lessen the strain on this dike, as well as on the dam, and also to straighten the channel on the Barkersville crossing, a long oblique dike, 19 B, was built out from Osage Point during the present season. This dike has had a very marked effect, and the crossing at Barkersville, which had been the shoalest on the reach, has disappeared. The straightening of the line of flow at this point was followed by similar effects below and enabled considerable extension to be given to the dikes extending out from Dodds Island, and also to those above Côte Sans Dessein. Further extensions are contemplated this year, which it is thought will definitely fix the channel in this the most difficult portion of the whole improvement.

In the late fall of 1894 a channel developed below Dike 29, the lowest then built, and made a very square crossing to the right bank below Bonnots Mill. The construction of the longitudinal Dike No. 30 was then ordered and the work was partly done last fall. It was extended this spring, and the construction of the cross dikes connected with it was begun. The channel before mentioned was moved downstream some 3,500 feet. With the extension of this dike and the completion of the cross dikes it is thought that another high water will put the river fairly on the line of rectification, and in anticipation of this event Dikes 35 and 36 have been extended, and Dikes 33 B, 33 C, and 34 A have been built. Some further extensions and some more short dikes on the right bank are contemplated to regulate the junction with the Osage River and complete the training of the river to Isbell Station.

This is the end of the work on the Osage division, and, as will be seen, it is nearly completed and appears very successful. The full results can not be expected for several years, or until the new shore lines build up and contract the river, but as willows are springing up on all the older accretions this process may be considerably accelerated, especially if we have a high river in 1896. No high water has been experienced since 1892—a most unusual state of affairs—and the progress of the work has been much delayed by this cause and its cost increased.

In all the earliest improved portions of the work a very decided channel improvement, both in depth, direction, and stability, is noted.

In the construction and extension of dikes on the Osage division during the year 6,205 piles were driven to an average penetration of 25 feet. Steam hammers were used entirely in driving, owing to the great quantity of gravel met with below the Osage. Wire netting was largely used for screening the dikes, and seems to give better results than the pole screens previously used. The total amount of dike work for the year aggregates 18,693 feet in length.

GASCONADE DIVISION.

As already stated, this division begins where the river leaves the right-hand bluffs, 3 miles below Isbell Station.

A group of dikes, 1 A, 3 A, and 5 A, are to be built this year at the head of the right-hand chute to deflect the full flow into St. Aubert Bend.

St. Aubert revetment.—The revetment of the left bank in this bend is 11,500 feet in length. It was begun April 22, 1895, and is complete except part of the upper bank paving. This work will be completed early in August.

St. Aubert Island revetment.—The protection of the north shore of this island is to be effected by a revetment 5,000 feet long and by two dikes, 7 A and 9 A. These dikes will be built this season. The revetment was begun May 23, 1895, and is still in progress, 3,000 feet of the mattress having been constructed.

Below St. Aubert Island the river enters Chamois Bend and follows the right bank, which has been revetted.

Chamois Bend revetment.—This work is 14,630 feet in length. Five thousand feet was built in the fall of 1894, and the balance during the present season. It is entirely completed except a portion of the upper bank paving, which is in progress and will probably be completed during July.

To hold the water against this bank, and generally to train it through the bend, a group of dikes opposite Chamois has been ordered and will be built this season. They are numbered 20 A, 22 A, 26 A, 28 A.

After leaving Chamois Bend the river crosses to the left bank at Portland, and thence follows the line of bluffs to Bluffton. It is held against this bank by a series of dikes built out from Portland Island and the right bank. One of these, Dike No. 14, is still incomplete. Its extension, to connect with the right bank, is contemplated this season.

A series of dikes, 7, 9, and 11, located above Bluffton, here turn the channel toward the right bank and close the chute to the left of Heckmanns Island. This crossing will be controlled by a series of dikes, Nos. 22, 24, 26, and 28, to be built this year, from Millers Island and the right bank adjoining. The river then enters Straubs Bend, which is to be revetted. It will be held against this shore by a group of dikes to be built out from Heckmanns Island, the shore of which will also require revetment. This last group of dikes and the revetments at Straubs Bend and Heckmanns Island can probably not be undertaken this year.

It is expected that these works will complete the rectification as far as the mouth of the Gasconade, the bank below Straubs Bend, in front of the United States boat yard, being already revetted. All the dike work in the Gasconade division has stood very well, only trifling repairs having been needed. The accretions behind the dikes have been very large, and the channel already shows a very decided improvement.

For details see reports of Assistant Engineers Yonge and Fox. (Appendixes J and K.)

REMOVAL OF OBSTRUCTIONS.

The snag boat belonging to the Commission began work on September 1 at the mouth of the Missouri River and removed all snags accessible as far up as Euphrase Bend, 232 miles from the mouth, by October 1. Returning downstream, the mouth of the river was reached October 13.

The boat then worked up to Dearing Landing, 140 miles from the mouth; turned back on October 31 and reached St. Louis November 5. The boat was held ready for any further calls for work till the end of November. December 1 she was laid up for the winter at Paducah, Ky. She was again put in commission March 5, and returned to the Missouri River March 14. By April 20 she had worked up to Kansas City, Mo., 391 miles from the mouth, and then turned back, reaching St. Louis May 11. On May 16 she reentered the Missouri River, worked upstream 286 miles; turned back on May 30 and reached St. Louis June 7. The water being then too high for effectual work, the boat was laid up temporarily.

Table of work done by the U. S. snag boat C. R. Suter during fiscal year ending June 30, 1895.

Name of river.	Snags destroyed.		Trees cut.	Drift piles removed.	Miles run.
	Number.	Estimated weight in tons of 2,000 pounds.			
Ohio	0	0	0	0	100
Mississippi	0	0	0	0	550
Missouri	1,975	21,350.5	826	4	2,100
Total	1,975	21,350.5	826	4	2,750

The appropriation act of March 2, 1895, contained the following item of appropriation:

Under Missouri River Commission: For improving Missouri River from its mouth to Sioux City, Iowa, including salaries, clerical, office, traveling, and miscellaneous expenses of the Missouri River Commission, surveys, permanent bench marks, and gauges, seven hundred and fifty thousand dollars: *Provided*, That forty thousand dollars thereof shall be expended, under the direction of the Secretary of War, for the extension of the improvements for the protection of the banks of the Missouri River in front of Sioux City and on the Iowa side of the river.

The $710,000 available for expenditure by the Commission has been allotted as follows:

For systematic improvement in first reach	$610,000
For operating snag boat	40,000
For office and traveling expenses and salaries of Commission	25,000
For surveys, gauges, physical data, and publications	35,000

OSAGE AND GASCONADE RIVERS.

The Commission's projects for the expenditure of the sums appropriated by the act of August 17, 1894, for work on the Osage and Gasconade rivers were approved by the Secretary of War December 15, 1894. On January 15, 1895, Maj. Charles J. Allen, Corps of Engineers, who had previously been in charge of these works, transferred to the Commission the unexpended balances of former appropriations for these rivers and the property pertaining thereto.

Osage River.—The project for improvement of this stream, adopted in 1871, has consisted in the removal of obstructions to navigation, such as snags and leaning timber, and in deepening channels over shoals by means of dredging, and the construction of cross and wing dams to concentrate the water over the shoal places.

The original estimated cost of the project was $230,000, but after that project was adopted the extent of river for which appropriations were made covered more ground than was originally considered, and for a number of years past no estimate of cost of the improvement by

removal of snags, shoals, etc., appears to have been rendered in annual reports.

The first efforts at improvement after the General Government assumed charge in 1871 were expended in dredging on the shoals. After this the method pursued consisted in the construction of dams and training walls and removal of snags, leaning timber, etc.

The construction of a lock and dam near the mouth of the river was authorized by the river and harbor act of September 19, 1890. The estimated cost of the lock and dam, as given in the Annual Report for 1892, was $200,000.

An improvement of a portion of the river was undertaken by the State of Missouri a number of years before the General Government assumed charge in 1871. This improvement consisted of wing dams built out from the banks to concentrate the flow of water in a narrow channel, with a view to securing an increase of depth through scour. These dams, however, were not kept in repair, and they did not secure the results desired.

Before improvement of the river was undertaken by the Government the channels were so obstructed by snags, trees, and shoals as to make navigation precarious at high stages of water and almost impossible in some portions of the river at low-water stage.

Every high stage of water carries more or less snags into the channel, besides causing scour of banks, resulting in obstructions which have to be removed.

The amount expended by the General Government upon the improvement to June 30, 1894, was $219,212.75.

It resulted in benefiting navigation on the river through removal of snags, leaning trees, shoals, etc., from its mouth to Mill Shoal, a distance of about 245 miles.

In September, 1894, a party of 12 men, provided with skiffs, a horse capstan, tackle, teams, dynamite, and axes and other tools, left Osage City (at the mouth) and, proceeding upstream, cleared the river of snags and overhanging trees as far as Monegaw Springs, 242 miles above the mouth. They arrived at Monegaw Springs in the latter part of November, where the party was disbanded, the outfit being shipped by rail to Osage City. The snags were removed by direct pulling of teams or by use of the capstan.

The work done was as follows:

Snags removed from the channel	279
Rocks removed from the channel	66
Overhanging trees felled	559
Drift trees cut up	561
Stumps grubbed out	26
Stumps cut off	16

The amount expended on this work during the fiscal year was $4,040.91. It resulted in quite thoroughly clearing the river of such obstructions as far up as Monegaw Springs.

At the beginning of the year Mr. Theo. Schoonmaker, assistant engineer on the construction of the lock, was engaged in an examination, begun in June, 1894, of the site of the proposed lock, including borings, for the purpose of obtaining data from which to make a complete estimate of the cost of the lock, the estimate of 1892 having been only approximate, and made without sufficient data as to cost of foundation. The examination was completed early in July, 1894. It was found that no change of location of the proposed lock was desirable.

In September, 1894, a line of levels was run from the lock site to the mouth of the Osage to check the levels run previously. A profile of

the river from the lock site to the mouth, and down through Osage Chute to Bonnots Mill, was made to assist in determining the proper elevation for the lower miter sill.

Based on information obtained from the above surveys the plans for the lock were revised, and specifications covering a portion of the lock work and estimates for the whole were prepared in accordance with the new plans. The plans and specifications were approved by the Chief of Engineers April 5, 1895.

In November, 1894, a plane-table survey was made from the site selected for the lock and dam to a point about 30 miles above to ascertain the additional amount of land that would be overflowed, due to a stationary dam of 10.5 feet lift, should the river reach the highest recorded flood stage. The results of this survey showed that such a dam would, at the above stage, cause an additional overflow of 636 acres within the limits of the survey, or an increase of about 20 per cent in area of land flooded. In view of these results the Commission decided February 11 that a modification of the plans of the dam to provide for a stationary dam of less lift than 10.5 feet and upon this a low, movable dam to bring the lift to 10.5 feet when raised would be advisable. It is proposed during the current season to make a complete examination of the site of the dam, and to prepare new plans and estimates of cost in accordance with the above decision.

By an act approved March 15, 1895, the legislature of the State of Missouri ceded to the United States jurisdiction over certain land acquired by the latter in January, 1894, lying on both sides of the river at the site of the proposed lock and dam. About 2 acres of additional land on the left bank will be needed for the service of the lock.

Plans and specifications for a lock house, office, and outbuildings having been prepared and approved, bids for their construction were opened February 21, 1895. On March 27 a contract was entered into with Matthew J. Brennan, the lowest bidder, for the construction of these buildings for the sum of $2,826.25; the delay in entering into contract having been caused by the late passage of the above act. The buildings were completed and accepted June 26, 1895. The work has been well done in all respects.

Bids were opened May 18, 1895, for constructing so much of the lock as it was thought could be built with the funds available (the amount of work covered by the above specifications). A contract was entered into for this work June 20, 1895, with McGee, Kahmann & Co., the lowest bidders, whose bid, $73,990, was much less than had been estimated for the work. Preliminary work under this contract has been begun, but the present high water will probably render it impossible to begin actual construction for some weeks to come.

Based on such data as we now have, it appears that the probable total cost of the lock and accessories will be about $190,000, and of the dam about $75,000, or a total of $265,000, as against the estimate of $200,000 submitted in 1892. For reasons above given this latter estimate could only be regarded as approximate.

A revised estimate of the cost of completing the lock and dam will be made as soon as some additional cross sections can be taken at the site of the dam and when the details of the combined stationary and movable dam are decided on. The above estimate of $265,000 may thereby be somewhat modified; but it is safe to say that $140,000 can be profitably expended during the fiscal year ending June 30, 1897, in completing the lock and dam, in removal of snags and other obstructions, and in improvement of the worst shoals.

For details of work done pertaining to the construction of lock and dam and accessories, see appended report of Assistant Engineer Schoonmaker. (Appendix L.)

It is proposed to devote the available balances to the purposes for which allotted, the snagging and survey work to be done in the current season. It is thought that the foundation for the lock can be completed this season.

Gasconade River.—The navigation of this stream before its improvement was undertaken by the Government was seriously obstructed by snags, logs, and leaning timber and at times almost suspended on account of numerous shoal crossings. Snags are liable to be found after every flood, which also carries more or less drift. The latter is apt to be deposited at the shoals or at other points, causing trouble to rafts and steamers.

Improvement by the Government commenced in 1880, and the project which was adopted consisted in the removal of snags and logs from the channels and of leaning timber from the banks of the river where necessary and in construction of wing dams and training walls to concentrate the flow of water upon the shoals and thus increase the depth over them.

The estimated cost of the improvement was $50,000, but as new obstructions are continually forming it will require appropriations from time to time to keep the channel open at low water after the principal work has been done.

The amount expended on the improvement to July 1, 1894, was $49,658.35, which resulted in quite generally freeing the river of obstructions from its mouth to Arlington, a river distance of 116 miles.

From October 2 to November 30, 1894, a small party was employed in removing snags, overhanging trees, etc., between the mouth and Arlington. The work done was as follows:

Snags removed from the channel	110
Rocks removed from the channel	2
Wrack heaps removed from the channel	1
Overhanging trees felled	23
Drift trees cut up	10
Stumps grubbed up	2
Stumps cut off	2

By this work all snags, etc., that then obstructed navigation between the mouth and Arlington were removed.

An examination of the river at Pryors Bend, 30 miles (river distance) from the mouth of the river, was made by Assistant Engineer J. O. Holman in September, 1894, who also continued the examination to the mouth. His report showed that serious erosion had been in progress at Pryors Island, threatening a cut-off through the narrow portion of the island. An estimate of the cost of revetting the portion of the bank where caving had occurred was submitted with his report.

In March, 1895, Assistant Engineer L. P. Butler was sent to Pryors Island to begin construction of the revetment above mentioned. A pile driver belonging to the Missouri River improvement, which had been temporarily transferred to this work, was repaired at the Gasconade boat yard and towed to Pryors Island. A barge for transporting the necessary rock was kindly loaned to the work by Capt. William L. Heckmann, who, with Mr. S. M. Lambeth, also furnished free of cost the brush and piles required, thus enabling a greater length of revetment to be constructed than would have been otherwise possible with the funds that could be devoted to this work. A total length of 760 feet of bank was revetted, the character and strength of the revetment

for different sections being varied to correspond with the exposure of the section. In addition to this, 196 piles were driven along other exposed portions of bank in the vicinity, the piles being furnished by the owners of the land threatened, who expect to complete at their own expense the revetment thus begun. The bend was also cleared of snags by this party, 32 snags being removed. The details of work done are given in the appended report of Assistant Butler. (Appendix M.)

A party was organized in the present month to perform the double duty of removing snags and other obstructions between the mouth and Arlington and to make an examination of the stream between the same limits, for which an allotment of $500 from the current appropriation had been made by the Commission (approved December 15, 1894). This party is in charge of Assistant Engineer Butler, with W. P. Pollard as foreman on snagging work. Mr. Butler is instructed to separate the survey and snagging parties if found advisable. Work was begun at the mouth of the river June 25, and at the close of the month had been carried to Powells Dam, 19 miles.

The amount expended during the fiscal year was $2,661.03, resulting in further benefit to navigation. With the balance of funds on hand it is proposed to complete the examination and the snagging work to Arlington, and to expend the remainder in the improvement of the worst shoals, beginning at the mouth.

The sum of $20,000 can be profitably expended during the fiscal year ending June 30, 1897, in continuing removal of obstructions and in improvement of shoals.

RECOMMENDATIONS AND ESTIMATES.

The current appropriation is the last of the four provided by the act of July 13, 1892. The continuous work rendered possible by this method of appropriation has enabled the improvement to be carried on in a very satisfactory and highly successful manner.

A stretch of 45 miles, embracing much difficult navigation, has been brought fairly under control, and although the final results can not as yet be announced, still everything indicates that they will be of great value and importance. The work of the coming year will be needed to complete the rectification of the river and, after that is done, one or two years, perhaps more, must elapse before the new shore lines are sufficiently built up to concentrate the discharge and give the increase of depth which is desired and expected. The natural channels on the Missouri are tortuous and exceedingly unstable, constantly shifting in position and difficult to run by boats of any size, and it is quite safe to say that the delays incident to these features are quite as much of a detriment to profitable navigation as any lack of depth of water. The work so far executed shows that these evils at least can be substantially eliminated, the channel can be given the shape and direction best suited to navigation, and can be kept there. This in itself is a vast improvement. Again, the natural channels, or at least the shoaler portions on bar crossings, fill up more or less when the river rises, so that increase in depth at such times is not at all equal to the rise of the water surface. In the rectified channels no such fill occurs, so that the full benefit of the rise in surface becomes available. This is another great gain. As to the depth which will ultimately prevail at low water throughout the rectified river, it is yet too early to speak definitely. Time must be allowed for the accretions to consolidate and build up before the full benefits of the contraction of width can be realized. The experience obtained from similar works on the Mississippi below St. Louis shows that a steady gain from year to year and for many years is to be

expected as the natural forces set in operation work out their legitimate results. It seems, however, beyond question that 6 or 8 feet can be certainly counted on, with a strong probability that even better results may be obtained. As the natural channels have but 3 feet depth, with occasionally only 2½ feet at this same stage, it will be readily seen that the improvement will be immense.

From the mouth of the Gasconade to the mouth of the Missouri is 110 miles, and the improvement of this stretch of river is required to complete that of the first reach. The net cost of the 45 miles above the Gasconade will be when complete about $2,000,000, or at the rate of $44,500 per mile. The Commission do not, however, consider this a safe figure to base their estimates on. The work at the Osage River mouth was exceedingly difficult and costly; nothing like it is expected at any other point on the river. Again, the work was largely experimental, and the experience gained will unquestionably render possible a very considerable reduction, both in the extent and cost of future work. The Commission are therefore disposed to think that the cost of carrying the improvement to the mouth of the river will lie between $3,000,000 and $3,500,000, with a strong probability that the lower figure will not be exceeded.

The advantages of the system of appropriation which has held during the last four years are so very great that the Commission venture to hope that Congress will see fit to continue it for another term of years. In fact, unless such should be the case they would expect that the estimate given herewith might prove entirely inadequate.

The estimates herewith submitted for the Osage River are for completing the lock and dam at Brennekes Shoal, already authorized by acts of Congress, and for removing snags and other obstructions from the river during the fiscal year ending June 30, 1897. If it be the intention of Congress that the lock and dam already authorized be the first of a series for the improvement of the Osage River, their construction should proceed in regular order upstream; and the location of the next lock would be about 15 miles above that of the present one.

The cost of this next lock and dam can not be definitely given at present, but it will probably not be less than that of the present one, which is estimated at $265,000, this estimate being based on the prices obtained for building a portion of the lock now under contract.

For the Gasconade River the Commission are not at present disposed to recommend any work other than such as has been heretofore carried on, viz, the removal of snags and other obstructions and the improvement of the various shoals by wing dams and revetment of caving banks. The estimate herewith submitted is for work of this character during the fiscal year ending June 30, 1897.

ESTIMATES FOR CONTINUING WORKS OF IMPROVEMENT FOR THE FISCAL YEAR ENDING JUNE 30, 1897.

Improving Missouri River from mouth to Sioux City, Iowa:	
Office and traveling expenses and salaries of Commission	$25,000
Surveys, gauges, physical data, and publications	35,000
Operating snag boat	40,000
Systematic improvement in first reach	900,000
	$1,000,000
Improving Osage River, Missouri:	
Completion of lock and dam at Brennekes Shoal	131,800
Snagging, etc	8,200
	140,000
Improving Gasconade River, Missouri:	
Snagging and improvement of shoals, etc	20,000

Money statements.

IMPROVING MISSOURI RIVER.

July 1, 1894, balance unexpended		$31,342.71
Amount appropriated by sundry civil act approved August 18, 1894		700,000.00
Amount appropriated by sundry civil act approved March 2, 1895		710,000.00
		1,441,342.71
June 30, 1895, amount expended during fiscal year		533,979.25
July 1, 1895, balance unexpended		907,363.46
July 1, 1895, outstanding liabilities	$142,683.82	
July 1, 1895, amount covered by uncompleted contracts	18,929.87	
		161,613.69
July 1, 1895, balance available		745,749.77
Amount that can be profitably expended in fiscal year ending June 30, 1897. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		1,000,000.00

IMPROVING GASCONADE RIVER, MISSOURI.

July 1, 1894, balance unexpended		841.65
Amount appropriated by act of August 17, 1894		5,000.00
		5,841.65
June 30, 1895, amount expended during fiscal year		2,661.03
July 1, 1895, balance unexpended		3,180.62
July 1, 1895, outstanding liabilities		229.89
July 1, 1895, balance available		2,950.73
Amount that can be profitably expended in fiscal year ending June 30, 1897. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		20,000.00

IMPROVING OSAGE RIVER, MISSOURI AND KANSAS.

July 1, 1894, balance unexpended		90,787.25
Amount appropriated by act of August 17, 1894		46,000.00
		136,787.25
June 30, 1895, amount expended during fiscal year		9,993.04
July 1, 1895, balance unexpended		126,794.21
July 1, 1895, outstanding liabilities	$737.30	
July 1, 1895, amount covered by uncompleted contracts	73,990.00	
		74,727.30
July 1, 1895, balance available		52,066.91
Amount that can be profitably expended in fiscal year ending June 30, 1897. Submitted in compliance with requirements of sections 2 of river and harbor acts of 1866 and 1867 and of sundry civil act of March 3, 1893.		140,000.00

Respectfully submitted.

CHAS. R. SUTER,
Lieut. Col. of Engineers, U. S. A.,
President Missouri River Commission.
A. MACKENZIE,
Lieut. Col. of Engineers, U. S. A.,
G. C. BROADHEAD,
RICHARD S. BERLIN,
CHAS. J. ALLEN,
Major, Corps of Engineers, U. S. A.

The SECRETARY OF WAR.
(Through the Chief of Engineers, U. S. A.)

Financial statement from July 1, 1894, to June 30, 1895.

Work.	Amount available July 1, 1894.			Appropriation.			Received by transfer from other allotments.	Total.	Amount expended.	Transferred to other allotments.	Total expended and transferred, etc.	Total balances June 30, 1895.	Outstanding liabilities June 30, 1895.	Balances available June 30, 1895.
	Balances of appropriation, act of Sept. 19, 1890.	Balances of appropriation, act of July 13, 1892.	Balances of appropriation, act of Mar. 3, 1893.	Act of Aug. 17, 1894.	Act of Aug. 18, 1894.	Act of March 2, 1895.								
Improving Missouri River from mouth to Sioux City, Iowa.														
Construction, repair, and care of plant	.....	$241.64	.....	.....	.....	.....	.....	$241.64	$201.21	.....	$201.21	$40.43	.....	$40.43
Repair and maintenance of works in vicinity of Kansas City	$0.02	.....	.....	.....	.....	.....	.....	.02	.02	.....	.02	.....	.....	.....
Repair of revetment in vicinity of Council Bluffs, Iowa	.....	.....	$64.93	.....	.....	.....	.....	64.93	34.03	.....	34.03	30.90	$7.30	23.60
Repair of revetment in Belmont Bend	.....	.....	453.88	.....	.....	.....	.....	453.88	192.96	.....	192.96	260.92	.....	260.92
Systematic improvement in First Reach	.....	133.18	10,594.91	.....	$450,000.00	$610,000.00	.....	1,070,728.09	386,426.74	.....	386,426.74	684,301.35	101,902.62	582,398.73
Operating snag boat	.....	6,443.97	328.39	.....	40,000.00	40,000.00	.....	86,772.36	32,435.58	.....	32,435.58	54,336.78	2,420.82	51,915.96
Office and traveling expenses and salaries of Commission	.....	1,364.51	1,868.15	.....	20,000.00	25,000.00	$1,500.00	49,732.66	19,781.57	.....	19,781.57	29,951.09	1,633.10	28,317.99
Surveys, gauges, physical data, and publications	.....	.....	1,897.99	.....	30,000.00	35,000.00	.....	66,897.99	25,198.55	.....	25,198.55	41,699.44	4,361.05	37,338.39
Surveys and observations	.....	6,606.73	.....	.....	.....	.....	.....	6,606.73	4,106.73	$2,500.00	6,606.73	.....	.....	.....
Gauges, physical data, and publications	.....	1,292.27	.....	.....	.....	.....	1,000.00	2,292.27	2,292.27	.....	2,292.27	.....	.....	.....
Surveys and examinations	26.48	.....	.....	.....	.....	.....	.....	26.48	3.88	.....	3.88	22.60	.....	22.60
Surveys	25.66	.....	.....	.....	.....	.....	.....	25.66	.....	.....	.....	25.66	.....	25.66
Rectification of the river at Omaha, Nebr	.....	.....	.....	.....	75,000.00	.....	.....	75,000.00	23,895.77	.....	23,895.77	51,104.23	17,628.22	33,476.01
At Atchison, Kans	.....	.....	.....	.....	35,000.00	.....	.....	35,000.00	17,729.60	.....	17,729.60	17,270.40	5,263.12	12,007.28
At St. Joseph, Mo	.....	.....	.....	.....	22,000.00	.....	.....	22,000.00	13,128.71	.....	13,128.71	8,871.29	141.37	8,729.92
At Leavenworth, Kans.	.....	.....	.....	.....	28,000.00	.....	.....	28,000.00	8,551.74	.....	8,551.74	19,448.26	8,359.03	11,089.23
Total	52.16	16,082.30	15,208.25	.....	700,000.00	710,000.00	2,500.00	1,443,842.71	533,979.36	2,500.00	536,479.36	907,363.35	141,716.63	765,646.72

Financial statement from July 1, 1894, to June 30, 1895—Continued.

Work.	Amount available July 1, 1894.			Appropriation.			Received by transfer from other allotments.	Total.	Amount expended.	Transferred to other allotments.	Total expended and transferred, etc.	Total balances June 30, 1895.	Outstanding liabilities June 30, 1895.	Balances available June 30, 1895.
	Balances of appropriation, act of Sept. 19, 1890.	Balances of appropriation, act of July 13, 1892.	Balances of appropriation, act of Mar. 3, 1893.	Act of Aug. 17, 1894.	Act of Aug. 18, 1894.	Act of March 2, 1895.								
Improving Osage River, Missouri and Kansas.														
Lock and dam (construction of lock and accessories)	*$42,655.18	*$40,000.00	.....	$44,200.00	.....	.....	.....	$126,855.18	$3,969.41	.....	$3,969.41	$122,885.77	$510.64	$122,375.13
Snagging operations	.....	*3,366.44	.....	1,000.00	.....	.....	.....	4,366.44	1,258.00	.....	1,258.00	3,108.44	226.66	2,881.78
Examination of the stream	.....	.....	.....	800.00	.....	.....	.....	800.00	.....	.....	.....	800.00	.....	800.00
Total	42,655.18	43,366.44	.....	46,000.00	.....	.....	.....	132,021.62	5,227,41	.....	5,227.41	126,794.21	737.30	126,056.91
Improving Gasconade River, Missouri.														
Balances, etc	.....	*138.11	.....	.....	.....	.....	.....	138.11	103.69	.....	103.69	34.42	.....	34.42
Removal of snags and other obstructions	.....	.....	.....	4,500.00	.....	.....	.....	4,500.00	1,853.80	.....	1,853.80	2,646.20	155.21	2,490.99
Examination of the stream from mouth to Arlington	.....	.....	.....	500.00	.....	.....	.....	500.00	.....	.....	.....	500.00	74.68	425,32
Total	.....	138.11	.....	5,000.00	.....	.....	.....	5,138.11	1,957.49	.....	1,957.49	3,180.62	229.89	2,950.73
Grand total	42,707.34	59,586.85	$15,208.25	51,000.00	$700,000.00	$710,000.00	$2,500.00	1,581,002.44	541,164.26	$2,500.00	543,664.26	1,037,338.18	142,683.82	894,654.36

*Balances transferred Jan. 15, 1895, from Maj. Charles J. Allen, Corps of Engineers.

Detailed statement, July 5, 1884, to June 30, 1895.

Work.	Balances of appropriations of 1882.	Appropriations and allotments.	From sales, etc.	Total available.	Expended to May 31, 1895.	Expended during the month of June, 1895.	Total expended to June 30, 1895.	Total balances June 30, 1895.	Outstanding liabilities June 30, 1895.	Balances available June 30, 1895.
Survey of the Missouri River above the Missouri River Falls, Fort Benton, Mont	.....	$15,000.00	.....	$15,000.00	$15,000.00	.....	$15,000.00	.....	.....	.....
Between Fort Benton, Mont., and Sioux City, Iowa:										
Office and inspection expenses of district officer	$2,000.00	4,749.00	.....	6,749.00	6,749.00	.....	6,749.00	.....	.....	.....
Purchase and repair of plant	2,000.00	58,751.00	.....	60,751.00	60,751.00	.....	60,751.00	.....	.....	.....
Work below Fort Benton	.....	31,500.00	.....	31,500.00	31,500.00	.....	31,500.00	.....	.....	.....
Improving Missouri River between Sioux City and Fort Benton	.....	48,250.00	$0.75	48,250.75	48,250.75	.....	48,250.75	.....	.....	.....
Survey between Fort Benton and Sioux City	.....	73,250.00	1.72	73,251.72	73,251.72	.....	73,251.72	.....	.....	.....
Office expenses and expenses of Commission	.....	5,000.00	53.24	5,053.24	5,053.24	.....	5,053.24	.....	.....	.....
Expenses proper of Commission, gauges, and physical data	.....	3,500.00	20.62	3,520.62	3,520.62	.....	3,520.62	.....	.....	.....
Total	4,000.00	225,000.00	76.33	229,076.33	229,076.33	.....	229,076.33	.....	.....	.....
Survey of Missouri River from its mouth to Fort Benton	8,844.39	.....	.....	8,844.39	8,844.39	.....	8,844.39	.....	.....	.....
Between Sioux City, Iowa, and the mouth of the river:										
Office and traveling expenses and salaries of Commission	.....	164,000.00	710.36	164,710.36	133,084.29	$1,674.98	134,759.27	$29,951.09	$1,633.10	$28,317.99
Additional surveys and establishment of permanent bench marks below Sioux City	.....	48,000.00	.....	48,000.00	48,000.00	.....	48,000.00	.....	.....	.....
Care of plant, preservation and observation of gauges, and collection and compilation of physical data	.....	37,000.00	.....	37,000.00	37,000.00	.....	37,000.00	.....	.....	.....
Purchase of towboat	.....	1,100.00	.....	1,100.00	1,100.00	.....	1,100.00	.....	.....	.....
Improving Missouri River in vicinity of Kansas City (at Parkville, Mo.)	.....	491,851.96	42.36	491,894.32	491,894.32	.....	491,894.32	.....	.....	.....
Improving Missouri River in vicinity of St. Joseph, Mo	.....	309,269.98	13.12	309,283.10	298,290.97	2,120.84	300,411.81	8,871.29	141.37	8,729.92

Detailed statement, July 5, 1884, to June 30, 1895—Continued.

Work.	Balances of appropriations of 1882.	Appropriations and allotments.	From sales, etc.	Total available.	Expended to May 31, 1895.	Expended during the month of June, 1895.	Total expended to June 30, 1895.	Total balances June 30, 1895.	Outstanding liabilities June 30, 1895.	Balances available June 30, 1895.
Between Sioux City, Iowa, and the mouth of the river—Continued.										
Improving Missouri River in vicinity of Kansas City, Mo	.....	$106,150.00	.....	$106,150.00	$106,150.00	.....	$106,150.00	.....	.....	.....
Special surveys	.....	14,500.00	.....	14,500.00	14,500.00	.....	14,500.00	.....	.....	.....
Expenses proper of Commission, gauges, and physical data	.....	33,800.00	$188.97	33,988.97	33,988.97	.....	33,988.97	.....	.....	.....
Omaha, Nebr	.....	195,736.64	.....	195,736.64	131,921.00	$12,711.41	144,632.41	$51,104.23	$17,628.22	$33,476.01
Sioux City, Iowa	.....	80,411.67	.....	80,411.67	80,411.67	.....	80,411.67	.....	.....	.....
Rulo, Nebr	.....	39,980.49	.....	39,980.49	39,980.49	.....	39,980.49	.....	.....	.....
Nebraska City, Nebr	.....	60,298.92	.....	60,298.92	60,298.92	.....	60,298.92	.....	.....	.....
Atchison, Kans	.....	95,639.14	.....	95,639.14	78,198.16	170.58	78,368.74	17,270.40	5,263.12	12,007.28
Leavenworth, Kans	.....	88,213.71	.....	88,213.71	61,888.84	6,876.61	68,765.45	19,448.26	8,359.03	11,089.23
Miami, Mo	.....	19,787.67	.....	19,787.67	19,787.67	.....	19,787.67	.....	.....	.....
Arrow Rock, Mo	.....	36,294.98	.....	36,294.98	36,294.98	.....	36,294.98	.....	.....	.....
Revetment in vicinity of Council Bluffs, Iowa	.....	128,800.00	.....	128,800.00	128,762.25	6.85	128,769.10	30.90	7.30	23.60
Completion of revetment on Nebraska City Island	.....	2,500.00	.....	2,500.00	2,500.00	.....	2,500.00	.....	.....	.....
Revetment in Belmont and Bon Ton bends	.....	172,000.00	.....	172,000.00	171,739.08	.....	171,739.08	260.92	.....	260.92
Repair and maintenance of works in vicinity of Kansas City	.....	70,500.00	7.22	70,507.22	70,507.22	.....	70,507.22	.....	.....	.....
Systematic improvement in First Reach	.....	2,187,200.00	100.00	2,187,300.00	1,439,236.36	63,762.29	1,502,998.65	684,301.35	101,902.62	582,398.73
Maintenance of gauges, collection of physical data, and publications	.....	51,000.00	5.50	51,005.50	51,005.50	.....	51,005.50	.....	.....	.....
Surveys and examinations between Sioux City, Iowa, and the mouth of the river	.....	91,275.00	52.94	91,327.94	91,279.68	.....	91,279.68	48.26	.....	48.26
Construction, repair, and care of plant	.....	439,764.84	.....	439,764.84	439,724.41	.....	439,724.41	40.43	.....	40.43
Surveys and observations	.....	27,500.00	.....	27,500.00	27,500.00	.....	27,500.00	.....	.....	.....
Operating snag boat (removal of snags, etc.)	$1,982.80	287,425.00	.....	289,407.80	230,174.11	4,896.91	235,071.02	54,336.78	2,420.82	51,915 96
Surveys, gauges, physical data, and publications	.....	80,000.00	.....	80,000.00	35,868.20	2,432.36	38,300.56	41,699.44	4,361.05	37,338.39
Total	1,982.80	5,360,000.00	1,120.47	5,363,103.27	4,361,087.09	94,652.83	4,455,739.92	907,363.35	141,716.63	765,646.72

Improving Osage River, Missouri and Kansas:										
Lock and dam (construction of lock and accessories)	.....	* $126,855.18	.....	$126,855.18	$1,859.35	$2,110.06	$3,969.41	$122,885.77	$510.64	$122,375.13
Snagging operations	.....	† 4,366.44	.....	4,366.44	1,166.50	91.50	1,258.00	3,108.44	226.66	2,881.78
Examination of the stream	.....	800.00	.....	800.00	.....	.....	.....	800.00	.....	800.00
Total	.....	132,021.62	.....	132,021.62	3,025.85	2,201.56	5,227.41	126,794.21	737.30	126,056.91
Improving Gasconade River, Missouri:										
Balances, etc	.....	‡ 138.11	.....	138.11	103.69	.....	103.69	34.42	.....	34.42
Removal of snags and other obstructions, etc	.....	4,500.00	.....	4,500.00	1,771.88	81.92	1,853.80	2,646.20	155.21	2,490.99
Examination of the stream from mouth to Arlington	.....	500.00	.....	500.00	.....	.....	.....	500.00	74.68	425.32
Total	.....	5,138.11	.....	5,138.11	1,875.57	81,92	1,957.49	3,180.62	229.89	2,950.73
Grand total	$14,827.19	5,737,159.73	$1,196.80	5,753,183.72	4,618,909.23	96,936.31	4,715,845.54	1,037,338.18	142,683.82	894,654.36

* Of this amount $82,655.18 was received Jan. 15, 1895, by transfer from Maj. Charles J. Allen, Corps of Engineers.
† Of this amount $3,366.44 was received Jan. 15, 1895, by transfer from Maj. Charles J. Allen, Corps of Engineers.
‡ Balance received by transfer Jan. 15, 1895, from Maj. Charles J. Allen, Corps of Engineers.

Consolidated statement, July 5, 1884, to June 30, 1895.

IMPROVING MISSOURI RIVER FROM MOUTH TO SIOUX CITY, IOWA.

Act of—		
July 5, 1884		$640,000.00
August 5, 1886		375,000.00
August 11, 1888		1,000,000.00
February 22, 1890		75,000.00
September 19, 1890		800,000.00
July 13, 1892		600,000.00
March 3, 1893		700,000.00
August 18, 1894		700,000.00
March 2, 1895		710,000.00
Total specific appropriations		$5,600,000.00
Balances from former appropriations:		
Act of August 2, 1882, applied to works above Sioux City, Iowa	$4,000.00	
Survey of Missouri River from mouth to Fort Benton	8,844.39	
Act of August 5, 1886, applied to removing obstructions from Missouri River	1,982.80	
Total balances		14,827.19
Received from sales and deposits		1,196.80
Total		5,616,023.99

IMPROVING OSAGE RIVER, MISSOURI AND KANSAS.

Act of August 17, 1894	$46,000.00	
Balances transferred January 15, 1895, from Maj. Chas. J. Allen, Corps of Engineers:		
Act of September 19, 1890	42,655.18	
Act of July 13, 1892	43,366.44	
Total		132,021.62

IMPROVING GASCONADE RIVER, MISSOURI.

Act of August 17, 1894	$5,000.00	
Balance transferred January 15, 1895, from Maj. Chas. J. Allen, Corps of Engineers:		
Act of July 13, 1892	138.11	
Total		5,138.11
Grand total		5,753,183.72
Expended to June 30, 1895:		
For improving Missouri River	$4,708,660.64	
For improving Osage River	5,227.41	
For improving Gasconade River	1,957.49	
Total		4,715,845.54
Balance June 30, 1895		1,037,338.18

Abstract of proposals opened January 5, 1895, for furnishing long-leaf yellow pine for improvement of Missouri River (Osage division), in accordance with advertisement of December 6, 1894, by Lieut. Col. Charles R. Suter, Corps of Engineers, president Missouri River Commission, St. Louis, Mo.

Articles, etc.	E. P. Cowan Lumber Co., Kansas City, Mo.		American Hardwood Lumber Co., St. Louis, Mo.		Ed. Holtschneider, Jefferson City, Mo.		Berthold & Jennings, St. Louis, Mo.		Interstate Lumber Co., Chattanooga, Tenn.	
	Per unit, M ft.	Total.*	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.
24 pieces, 2 by 12 inches, 16 feet long (1,248 feet, B. M.)	$20.25	.....	$22.50	$28.08	$17.75	$22.15	$18.38	$22.93	$23.90	$29.82
200 pieces, 4 by 6 inches, 24 feet long (9,600 feet, B. M.)	19	.....	22.50	211.20	17.75	170.40	18.38	176.45	23.90	229.44
200 pieces, 4 by 6 inches, 28 feet long (11,200 feet, B. M.)	20	.....	22.50	252.00	17.75	198.80	18.38	205.85	23.90	267.68
200 pieces, 6 by 8 inches, 22 feet long (17,600 feet, B. M.)	19	.....	22.50	387.20	17.75	312.40	18.38	323.48	23.90	420.64
600 pieces, 5 by 8 inches, 24 feet long (48,000 feet, B. M.)	19.25	.....	22.50	1,056.00	17.75	852.00	18.38	882.24	23.90	1,147.20
2,100 pieces, 4 by 6 inches, 16 feet long (67,200 feet, B. M.)	17.25	.....	22.50	1,478.40	17.75	1,192.80	18.38	1,235.13	23.90	1,606.08
Total	.....	.....	.....	3,412.88	.....	2,748.55	.....	2,846.08	.....	3,700.86

Articles, etc.	Jno. J. Ganahl Lumber Co., St. Louis, Mo.		Central Coal and Coke Co., St. Louis, Mo.		St. Louis Refrigerator and Wooden Gutter Co., St. Louis, Mo.		Hazelhurst Lumber Co., Hazelhurst, Miss.		Oriel Lumber Co., St. Louis, Mo.	
	Per unit, M ft.	Total.	Per unit, M ft.	Total.*	Per unit, M ft.	Total.	Per unit, M ft.	Total.†	Per unit, M ft.	Total.*
24 pieces, 2 by 12 inches, 16 feet long (1,248 feet, B. M.)	$24	$29.95	$19	.....	$18.70	$23.33	$20.50	.....	$20	.....
200 pieces, 4 by 6 inches, 24 feet long (9,600 feet, B M.)	23	220.80	19	.....	18.70	179.52	20.50	.....	19	.....
200 pieces, 4 by 6 inches, 28 feet long (11,200 feet, B. M.)	24	268.80	19	.....	18.70	209.44	20.50	.....	20	.....
200 pieces, 6 by 8 inches, 22 feet long (17,600 feet, B. M.)	23	404.80	19	.....	18.70	329.12	20.50	.....	19	.....
600 pieces, 5 by 8 inches, 24 feet long (48,000 feet, B. M.)	23	1,104.00	19	.....	18.70	897.60	20.50	.....	19	.....
2,100 pieces, 4 by 6 inches, 16 feet long (67,200 feet, B. M.)	21	1,411.20	19	.....	18.70	1,256.64	20.50	.....	19	.....
Total	.....	3,439.55	.....	.....	.....	2,895.65	.....	.....	.....	.....

* Incomplete; no guaranty given. † Incomplete; no certificate as to qualification of the guaranty.

Abstract of proposals opened February 21, 1895, for furnishing white oak piling for Omaha, Nebr., in accordance with advertisement of February 6, 1895, by First Lieut. J. C. Sanford, Corps of Engineers, secretary Missouri River Commission, St. Louis, Mo.

Articles, etc.	St. Louis Refrigerator and Wooden Gutter Co., St. Louis, Mo.						J. M. Craig, Cape Girardeau, Mo., at Cairo, Ill.		Alf. A. Raymond, Omaha, Nebr., on nearest accessible siding to work.	
	At Cache, Ark.		At barging point within stated limits.		On nearest accessible siding to work.					
	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.
	Cents.		*Cents.*		*Cents.*		*Cents.*		*Cents.*	
74 piling, 55 feet long (4,070 linear feet)	9	$366.30	18.99	.....	18.99	.....	10	$407.00	16.60	$675.62
147 piling, 50 feet long (7,350 linear feet)	9	661.50	18.99	.....	18.99	.....	10	735.00	16.60	1,220.10
1,105 piling, 45 feet long (49,725 linear feet)	9	4,475.25	18.99	.....	18.99	.....	9.50	4,473.87½	16.60	8,254.35
147 piling, 40 feet long (5,580 linear feet)	9	502.20	18.99	.....	18.99	.....	9.50	530.10	16.60	926.28
74 piling, 35 feet long (2,590 linear feet)	9	233.10	18.99	.....	18.99	.....	9.50	246.05	16.60	429.94
Total	.....	6,238.35	.....	$13,162.92	.....	$13,162.92	.....	6,642.02½	.....	11,506.29

Abstract of proposals opened February 21, 1895, for furnishing white oak piling for Omaha, Nebr., etc.—Continued.

Articles, etc.	Huse & Connolly, Omaha, Nebr., on nearest accessible siding to work.		C. E. H. Campbell, Council Bluffs, Iowa.				Calhoun Coal and Lumber Co., Kansas City, Mo., on nearest accessible siding to work.		C. L. Chaffee, Omaha, Nebr., on nearest accessible siding to work.	
			At Poplar Bluffs, Mo.		On bank of river at Council Bluffs, Iowa.*					
	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.
	Cents.		*Cents.*						*Cents.*	
74 piling, 55 feet long (4,070 linear feet)	0.56	$2,279.20	7.50	$305.25	.....	.....	.....	.....	17.50	$712.25
147 piling, 50 feet long (7,350 linear feet)	41	3,013.50	7.50	551.25	.....	.....	.....	.....	17	1,249.50
1,105 piling, 45 feet long (49,725 linear feet)	41	20,387.25	7.50	3,729.37	.....	.....	.....	.....	16	7,956.00
147 piling, 40 feet long (5,580 linear feet)	31	1,822.80	7.50	441.00	.....	.....	.....	.....	15.25	850.95
74 piling, 35 feet long (2,590 linear feet)	29	751.10	7.50	194.25	.....	.....	.....	.....	15	388.50
Total	.....	28,253.85	.....	5,221.12	.....	$13,226.85	.....	$11,475.00	.....	11,157.20

* On nearest accessible siding to work, $12,530.70.

Abstract of proposals opened February 21, 1895, for furnishing long-leaf yellow pine for Leavenworth, Kans., in accordance with advertisement of February 6, 1895, by First Lieut. J. C. Sanford, Corps of Engineers, secretary Missouri River Commission, St. Louis, Mo.

Articles, etc.	Kansas City Lumber Co., Kansas City, Mo., on nearest accessible siding to work.		C. L. Chaffee, Omaha, Nebr., on nearest accessible siding to work.		Frank G. Markart, Leavenworth, Kans., on nearest accessible siding to work.		Alfred A. Raymond, Omaha, Nebr., on nearest accessible siding to work.		Calhoun Coal and Lumber Co., Kansas City, Mo., on nearest accessible siding to work.	
	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.
732 pieces 6 by8 inches, 22 feet long (64,416 feet, B. M.)	$17.50	$1,127.28	$16.50	$1,062.86	$20	$1,288.32	$16.80	$1,082.19	.....	.....
300 pieces, 4 by8 inches, 22 feet long (17,600 feet, B. M.)	17.50	308.00	16.50	290.40	20	352.00	16.80	295.68	.....	.....
288 pieces, 4 by8 inches, 24 feet long (18,432 feet, B. M.)	17.50	322.56	16.50	304.13	20	368.64	16.80	309.66	.....	.....
82 pieces, 6 by 8 inches, 12 feet long (3,936 feet, B. M.)	16.50	64.94	15.50	61.00	20	79.72	16.80	66.12	.....	.....
164 pieces, 4 by8 inches, 12 feet long (5,248 feet, B. M.)	16.50	86.59	15.50	81.34	20	104.96	16.80	88.17	.....	.....
102 pieces, 4 by8 inches, 16 feet long (4,352 feet, B. M.)	16.50	71.80	15.50	67.46	20	87.04	16.80	74.11	.....	.....
Total	.....	1,981.17	.....	1,867.19	.....	2,280.68	.....	1,915.93	.....	$1,878.00

Abstract of proposals opened February 21, 1895, for furnishing long-leaf yellow pine for Leavenworth, Kans., etc.—Continued.

Articles, etc.	St. Louis Refrigerator and Wooden Gutter Co., St. Louis, Mo.						C. E. H. Campbell, Council Bluffs, Iowa, at Beaumont, Tex.		Interstate Lumber Co., Chattanooga, Tenn., at Heartpine, Ga.	
	At Hattiesburg, Miss.		At barging point within stated limits.		On nearest accessible siding to the work.					
	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.*	Per unit, M ft.	Total.†
732 pieces, 6 by 8 inches, 22 feet long (64,416 feet, B. M.)	$8.90	$573.30	$16.95	.....	$17.55	.....	$9	$579.74	$11	$708.57
300 pieces, 4 by 8 inches, 22 feet long (17,600 feet, B. M.)	8.90	156.64	16.95	.....	17.55	.....	9	158.40	11	193.60
288 pieces, 4 by 8 inches, 24 feet long (18,432 feet, B. M.)	8.90	164.04	16.95	.....	17.55	.....	9	165.89	11	202.75
82 pieces, 6 by 8 inches, 12 feet long (3,936 feet, B. M.)	8.90	35.03	16.95	.....	17.55	.....	9	35.42	11	43.29
164 pieces, 4 by 8 inches, 12 feet long (5,248 feet, B. M.)	8.90	46.70	16.95	.....	17.55	.....	9	47.23	11	57.72
102 pieces, 4 by 8 inches, 16 feet long (4,352 feet, B. M.)	8.90	38.73	16.95	.....	17.55	.....	9	39.17	11	47.87
Total	.....	1,014.44	.....	$1,932.03	.....	$2,000.42	.....	1,025.85	.....	1,253.80

*At barging point within stated limits, $2,165.70; on nearest accessible siding to the work, $2,051.70.
†At barging point within stated limits, $2,462.05; on nearest accessible siding to the work, $2,462.05.

Abstract of proposals opened February 21, 1895, for furnishing white oak piling for Leavenworth, Kans., in accordance with advertisement of February 6, 1895, by First Lieut. J. C. Sanford, Corps of Engineers, secretary Missouri River Commission, St. Louis, Mo.

Articles, etc.	J. M. Craig, Cape Girardeau, Mo., at Cario, Ill.		C. L. Chaffee, Omaha, Nebr., on nearest accessible siding to work.		Frank G. Markart, Leavenworth, Kans., on nearest accessible siding to work.		Alfred A. Raymond, Omaha, Nebr., on nearest accessible siding to work.	
	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.
	Cts.		*Cts.*		*Cts.*		*Cts.*	
21 piling, 50 feet long (1,050 linear feet)	9½	$99.75	17	$178.50	25	$262.50	16	$168.00
43 piling, 45 feet long (1,935 linear feet)	9½	183.82½	16	309.60	22	425.70	16	309.60
445 piling, 40 feet long (17,800 linear feet)	9½	1,691.00	15¼	2,714.50	20	3,560.00	16	2,848.00
68 piling, 35 feet long (2,380 linear feet)	9½	226.10	15	357.00	20	476.00	16	380.80
33 piling, 30 feet long (990 linear feet)	9½	94.05	14	138.60	20	198.00	16	158.40
Total	.....	2,294.72½	.....	3,698.20	.....	4,922.20	.....	3,864.80

Abstract of proposals opened February 21, 1895, for furnishing white oak piling for Leavenworth, Kans., etc.—Continued.

Articles, etc.	Calhoun Coal and Lumber Co., Kansas City, Mo., on nearest accessible siding to work.		St. Louis Refrigerator and Wooden Gutter Co., St. Louis, Mo.						C. E. H. Campbell, Council Bluff, Iowa, at Poplar Bluff, Mo., and vicinity.	
			At Cache, Ark.		At barging point within stated limits.		On nearest accessible siding to the work.			
	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.*
	Cts.		*Cts.*		*Cts.*		*Cts.*		*Cts.*	
21 piling, 50 feet long (1,050 linear feet)	.....	.....	9	$94.50	18.99	.....	19.69	.....	7½	$78.75
43 piling, 45 feet long (1,935 linear feet)	.....	.....	9	174.15	18.99	.....	19.69	.....	7½	145.12
445 piling, 40 feet long (17,800 linear feet)	.....	.....	9	1,602.00	18.99	.....	19.69	.....	7½	1,335.00
68 piling, 35 feet long (2,380 linear feet)	.....	.....	9	214.92	18.99	.....	19,69	.....	7½	178.50
33 piling, 30 feet long (990 linear feet)	.....	.....	9	89.10	18.99	.....	19.69	.....	7½	74.25
Total	.....	$3,877.00	.....	2,174.67	.....	$4,587.03	.....	$4,756.11	.....	1,811.62

* At barging point within stated limits, $4,589.45; on nearest accessible siding to the work, $4,347.90.

Abstract of proposals opened February 21, 1895, for furnishing long-leaf yellow pine for Omaha, Nebr., in accordance with advertisement of February 6, 1895, by First Lieut. J. C. Sanford, Corps of Engineers, secretary of Missouri River Commission, St. Louis, Mo.

Articles, etc.	St. Louis Refrigerator and Wooden Gutter Co., St. Louis, Mo.				Alfred A. Raymond, Omaha, Nebr., on nearest accessible siding to work.		Interstate Lumber Co., Chattanooga, Tenn., at Heartpine, Ga.	
	At Hattiesburg, Miss.		On nearest accessible siding to the work.					
	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.*
2,370 pieces, 6 by 8 inches, 22 feet long (208,560 feet, B. M.)	$8.90	$1,856.18	$16.95	.....	$16.80	$3,503.80	$11	$2,294.16
522 pieces, 4 by 8 inches, 22 feet long (30,624 feet, B. M.)	8.90	272.55	16.95	.....	16.80	514.49	11	336.86
522 pieces, 4 by 8 inches, 24 feet long (33,408 feet, B. M.)	8.90	297.33	16.95	.....	16.80	561.25	11	367.48
220 pieces, 6 by 8 inches, 12 feet long (10,560 feet, B. M.)	8.90	93.98	16.95	.....	16.80	177.41	11	116.16
440 pieces, 4 by 8 inches, 12 feet long (14,080 feet, B. M.)	8.90	125.31	16.95	.....	16.80	236.55	11	154.88
222 pieces, 4 by 8 inches, 16 feet long (9,472 feet, B. M.)	8.90	84.30	16.95	.....	16.80	159.13	11	104.19
Total	.....	2,729.65	.....	$5,198.63	.....	5,152.63	.....	3,373.73

Articles, etc.	Huse & Connolly, Omaha, Nebr., on nearest accessible siding to work.		C. E. H. Campbell, Council Bluffs, Iowa, at Beaumont, Tex.		Calhoun Coal and Lumber Co., Kansas City, Mo., on nearest accessible siding to work.		C. L. Chaffee, Omaha, Nebr., on nearest accessible siding to work.	
	Per unit, M ft.	Total.	Per unit, M ft.	Total.†	Per unit, M ft.	Total.	Per unit, M ft.	Total.
2,370 pieces, 6 by 8 inches, 22 feet long (208,560 feet, B. M.)	$17.50	$3,649.80	$9	$1,877.04	.....	.....	$16.50	$3,441.24
522 pieces, 4 by 8 inches, 22 feet long (30,624 feet, B. M.)	17.50	535.92	9	275.61	.....	.....	16.50	505.30
522 pieces, 4 by 8 inches, 24 feet long (33,408 feet, B. M.)	17.50	584.64	9	300.67	.....	.....	16.50	551.23
220 pieces, 6 by 8 inches, 12 feet long (10,560 feet, B. M.)	17.50	184.80	9	95.04	.....	.....	15.50	163.68
440 pieces, 4 by 8 inches, 12 feet long (14,080 feet, B. M.)	17.50	246.40	9	126.72	.....	.....	15.50	218.24
222 pieces, 4 by 8 inches, 16 feet long (9,472 feet, B. M.)	17.50	165.76	9	85.25	.....	.....	15.50	146.81
Total	.....	5,367.32	.....	2,760.33	.....	$5,055.00	.....	5,026.50

Abstract of proposals opened February 21, 1895, for furnishing long-leaf yellow pine for Omaha, Nebr., etc.—Continued.

Articles, etc.	Kansas City Lumber Co., Kansas City, Mo., on nearest accessible siding to work.		Guion & Ledwich, Omaha, Nebr.			
			At Beaumont, Tex.		On nearest accessible siding to the work.	
	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.
2,370 pieces, 6 by 8 inches, 22 feet long (2,085.60 feet, B. M.)	$17.50	$3,649.80	$10	$2,085.60	$16.90	$3,524.66
522 pieces, 4 by 8 inches, 22 feet long (30,624 feet, B. M.)	17.50	535.92	10	306.24	16.90	517.55
522 pieces, 4 by 8 inches, 24 feet long (33,408 feet, B. M.)	17.50	584.64	10	334.08	16.90	564.60
220 pieces, 6 by 8 inches, 12 feet long (10,560 feet, B. M.)	16.50	174.24	10	105.60	16.90	178.45
440 pieces, 4 by 8 inches, 12 feet long (14,080 feet, B. M.)	16.50	232.32	10	140.80	16.90	237.95
222 pieces, 4 by 8 inches, 16 feet long (9,472 feet, B. M.)	16.50	156.28	10	94.72	16.90	160.07
Total	.....	5,333.20	.....	3,067.04	.....	5,183.28

*At barging points within stated limits or on nearest accessible siding to work, $6,824.16.
†Bank of river at Council Bluffs, Iowa, $5,827.37; on nearest accessible siding to work, $5,520.66.

Abstract of proposals opened February 21, 1895, for building lock house, office, and outbuildings at Brennekes Shoal, Osage River, Missouri, in accordance with advertisement of February 6, 1895, by First Lieut. J. C. Sanford, Corps of Engineers, secretary Missouri River Commission, St. Louis, Mo.

	W. H. Kolkmeyer & Co., Jefferson City, Mo.		Shobe, Pahmeier & Co., Chamois, Mo.		M. J. Brennan, St. Louis, Mo.		E. L. Wagner, St. Louis, Mo.	
	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.
Lock house, office, and outbuildings complete, except masonry and excavation	.....	$3,250.00	.....	$3,900.00	.....	$2,470.00	.....	$2,945.00
Excavation (125 cubic yards)	$0.45	56.25	$1.00	125.00	$0.25	31.25	$0.30	37.50
Masonry (57 cubic yards)	5.40	307.80	6.00	342.00	5.00	285.00	4.40	250.80
Pier stone (No. 20)	1.65	33.00	5.00	100.00	2.00	40.00	2.00	40.00
Total	.....	3,647.05	.....	4,467.00	.....	2,826.25	.....	3,273.30

	Jno. H. Brown, St. Louis, Mo.		Banks & Kernish, Webster Groves, Mo.		Burns Building Co., St. Louis, Mo.	
	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.
Lock house, office, and outbuildings complete, except masonry and excavation	.....	$2,681.03	.....	$2,772.00	.....	$4,714.00
Excavation (125 cubic yards)	$0.25	31.15	$0.30	37.50	$0.40	50.00
Masonry (57 cubic yards)	4.30	245.10	3.50	199.50	19.50	1,111.50
Pier stone (No. 20)	2.00	40.00	2.50	50.00	8.50	170.00
Total	.....	2,997.38	.....	3,059.00	.....	6,045.50

Abstract of proposals opened April 19, 1895, for furnishing long-leaf yellow pine, for improvement of Missouri River (Osage division), in accordance with advertisement of April 1, 1895, by Lieut. Col. Charles R. Suter, Corps of Engineers, president Missouri River Commission, St. Louis, Mo.

Articles.	Berthold & Jennings, St. Louis, Mo.		St. Louis Refrigerator and Wooden Gutter Co., St. Louis, Mo.		Edward Hottschneider, Jefferson City, Mo.		Victor Lambou, New Orleans, La.		John M. Byrne, Kansas City, Mo.	
	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.	Per unit, M ft.	Total.
2,583 pieces, 2 by 8 inches, 20 feet long (68,880 feet, B. M.)	$18.75	$1,291.50	$16.45 per M.		.....	$16.50	$1,136.52	$30	$2,066.40	$17.50	$1,170.96
29 pieces, 2 by 16 inches, 20 feet long (1,547 feet, B. M.)	18.75	29.01			.....	20.00	30.94	30	46.41	18.50	28.62
192 pieces, 2 by 8 inches, 24 feet long (6,144 feet, B. M.)	18.75	115.20			.....	17.50	107.52	30	184.32	18.00	110.59
8 pieces, 4 by 10 inches, 20 feet long (533 feet, B. M.)	18.75	9.99			.....	20.00	10.66	30	15.99	17.00	9.06
19 pieces, 4 by 10 inches, 24 feet long (1,520 feet, B. M.)	18.75	28.50			.....	20.00	30.40	30	45.60	18.00	27.36
76 pieces, 4 by 10 inches, 28 feet long (7,093 feet, B. M.)	18.75	132.99			.....	20.00	141.86	30	212.79	20.00	141.86
4 pieces, 4 by 10 inches, 30 feet long (400 feet, B. M.)	18.75	7.50			.....	20.00	8.00	30	12.00	21.00	8.40
24 pieces, 12 by 14 inches, 25 feet long (8,400 feet, B. M.)	18.75	157.50			.....	20.00	168.00	30	252.00	21.00	176.40
500 pieces, 1 by 12 inches, 16 feet long (8,000 feet, B. M.)	18.75	150.00			.....	16.50	132.00	30	240.00	17.00	135.00
100 pieces, 2 by 12 inches, 16 feet long (3,200 feet, B. M.)	18.75	60.00			.....	18.00	57.60	30	96.00	17.00	54.40
14 pieces, 8 by 16 inches, 26 feet long (3,883 feet, B. M.)	18.75	72.81			.....	23.00	89.31	30	116.49	21.00	81.54
30 pieces, 6 by 8 inches, 22 feet long (2,640 feet, B. M.)	18.75	49.50			.....	18.00	47.52	30	79.20	18.00	47.52
Total	.....	2,104.50	.....	1,846.35	.....		1,960.33	.....	3,367.20	.....	1,991.71

Abstract of proposals opened May 18, 1895, for building portion of Lock No. 1, Osage River, Missouri and Kansas, in accordance with advertisement of April 18, 1895, by First Lieut. J. C. Sanford, Corps of Engineers, secretary Missouri River Commission, St. Louis, Mo.

Description.	Approximate quantity.	McGee, Kahmann & Co., Kansas City, Mo.		Fruin-Bambrick Construction Company, St. Louis, Mo.		Alonzo J. Tullock, Leavenworth, Kans.		Thompson & Gray, St. Louis, Mo.	
		Per unit.	Total.	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.
Grubbing and clearing complete	.....	.....	$60.00	.....	$70.00	.....	$200.00	.....	$100.00
Piles in cofferdam..linear feet..	7,500	$0.25	1,875.00	$0.41¼	3,093.75	$0.25	1,875.00	$0.33	2,475.00
Sheeting.....feet, B. M..	220,000	26.00	5,720.00	46.00	10,120.00	33.00	7,260.00	58.30	12,826.00
Cofferdam filling..cubic yds..	3,000	.28	840.00	.69	2,070.00	.40	1,200.00	.57	1,710.00
Excavation .....do....	25,000	.24	6,000.00	.58	14,500.00	.65	16,250.00	.58	14,500.00
Embankment.....do....	6,000	.27	1,620.00	.30	1,800.00	.32	1,920.00	.31	1,860.00
Puddling .....do....	3,000	.40	120.00	1.44	432.00	1.50	450.00	2.48	744.00
Concrete.....do....	3,600	4.75	17,100.00	9.75	35,100.00	5.30	19,080.00	3.51	12,636.00
Backing masonry.....do....	1,600	5.00	8,000.00	11.50	18,400.00	8.40	13,440.00	7.00	11,200.00
Rock-face masonry ....do....	585	12.00	7,020.00	17.25	10,091.25	12.25	7,166.25	10.95	6,405.75
Pointed-face masonry..do....	232	15.00	3,480.00	23.00	5,336.00	13.50	3,132.00	12.00	2,784.00
Cut-stone masonry.....do....	38	20.00	760.00	28.75	1,092.50	22.00	836.00	20.00	760.00
Sills .....do....	83	20.00	1,660.00	30.00	2,490.00	20.00	1,660.00	23.00	1,909.00
Quoins.....do....	10	20.00	200.00	46.00	460.00	36.00	360.00	30.00	300.00
Coping.....do....	10	20.00	200.00	30.00	300.00	22.50	225.00	30.00	300.00
Stone filling .....do....	1,020	1.50	1,530.00	1.38	1,407.60	1.50	1,530.00	1.45	1,479.00
Riprap, hand placed ...do....	320	1.50	480.00	2.87½	920.00	1.25	400.00	1.75	560.00
Piles in permanent construction.....linear feet..	55,000	.25	13,750.00	.46	25,300.00	.30	16,500.00	.40	22,000.00
Timber in permanent construction.....feet, B. M..	140,000	25.00	3,500.00	40.25	5,635.00	35.00	4,900.00	58.00	8,120.00
Bolt holes in masonry, linear feet	100	.75	75.00	.70	70.00	.60	60.00	.75	75.00
Total.....	.....	.....	73,990.00	.....	138,688.10	.....	98,444.25	.....	102,743.75

Description.	James Stewart & Co., St. Louis, Mo.		Van Sant & Lutes, St. Louis, Mo.		Hill & O'Meara Construction Company, St. Louis, Mo.		Math. J. Brennan, St. Louis, Mo.	
	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.
Grubbing and clearing complete.....	.....	$100.00	.....	.....	.....	$100.00	.....	$175.00
Piles in cofferdam .....linear feet..	$0.21	1,575.00	$0.30	$2,250.00	$0.16½	1,237.50	$0.34	2,550.00
Sheeting .....feet, B. M..	32.20	7,084.00	40.00	8,800.00	24.35	5,357.00	40.00	8,800.00
Cofferdam filling.....cubic yards..	.40	1,200.00	.30	900.00	.60	1,800.00	.60	1,800.00
Excavation.....do....	.75	18,750.00	.45	11,250.00	.60	15,000.00	1.15	28,750.00
Embankment.....do....	.25	1,500.00	.30	1,800.00	.45	2,700.00	.34	2,040.00
Puddling.....do....	1.75	525.00	1.00	300.00	1.00	300.00	.85	255.00
Concrete .....do....	5.80	20,880.00	5.00	18,000.00	5.64	20,304.00	5.50	19,800.00
Backing masonry.....do....	6.30	10,080.00	10.00	16,000.00	8.60	13,760.00	7.15	11,440.00
Rock-face masonry.....do....	9.20	5,382.00	20.00	11,700.00	11.25	6,581.25	10.75	6,288.75
Pointed-face masonry .....do....	10.35	2,401.20	26.00	6,032.00	13.65	3,166.80	12.75	2,958.00
Cut-stone masonry .....do....	19.00	722.00	30.00	1,140.00	14.00	532.00	14.75	560.50
Sills.....do....	20.00	1,660.00	30.00	2,490.00	23.00	1,909.00	22.00	1,826.00
Quoins .....do....	23.00	230.00	30.00	300.00	23.00	230.00	30.25	302.50
Coping .....do....	20.75	207.50	30.00	300.00	23.00	230.00	17.55	175.50
Stone filling.....do....	1.40	1,428.00	2.00	2,040.00	1.20	1,224.00	1.25	1,275.00
Riprap, hand placed.....do....	2.00	640.00	2.00	640.00	1.30	416.00	1.70	544.00
Piles in permanent construction.linear feet	.23	12,650.00	.22	12,100.00	.16½	9,075.00	.40	22,000.00
Timber in permanent construction, feet, B. M.....	27.50	3,850.00	24.00	3,360.00	24.35	3,409.00	40.00	5,600.00
Bolt holes in masonry....linear feet..	1.00	100.00	.90	90.00	.25	25.00	.50	50.00
Total	.....	90,964.70	.....	99,492.00	.....	87,356.55	.....	117,190.25

Abstract of proposals opened May 18, 1895, for building portion of Lock No. 1, Osage River, Missouri and Kansas, etc.—Continued.

Description.	Geo. Burnett & Co., St. Louis, Mo.		Roberts, Kolkmeyer & Co., Jefferson City, Mo.		C. Irwin McDonald, Pittsburg, Pa.	
	Per unit.	Total.	Per unit.	Total.	Per unit.	Total.
Grubbing and clearing complete	.....	$100.00	.....	$90.00	.....	$300.00
Piles in cofferdam, linear feet	$0.15	1,125.00	$0.30	2,250.00	$0.22½	1,687.50
Sheeting, feet, B. M.	30.00	6,600.00	22.00	4,840.00	25.00	5,500.00
Cofferdam filling, cubic yards	.25	750.00	.60	1,800.00	.35	1,050.00
Excavation, do	.45	11,250.00	.55	13,750.00	.35	8,750.00
Embankment, do	.20	1,200.00	.30	1,800.00	.40	2,400.00
Puddling, do	1.00	300.00	1.00	300.00	2.50	750.00
Concrete, do	4.30	15,480.00	4.50	16,200.00	6.50	23,400.00
Backing masonry, do	8.00	12,800.00	5.50	8,800.00	7.50	12,000.00
Rock-face masonry, do	10.50	6,142.50	9.00	5,265.00	9.00	5,265.00
Pointed-face masonry, do	13.50	3,132.00	12.00	2,784.00	10.00	2,320.00
Cut-stone masonry, do	15.60	592.80	16.00	608.00	17.00	646.00
Sills, do	16.00	1,328.00	20.00	1,660.00	20.00	1,660.00
Quoins, do	16.00	160.00	20.00	200.00	25.00	250.00
Coping, do	16.00	160.00	16.00	160.00	17.00	170.00
Stone filling, do	1.00	1,020.00	1.25	1,275.00	1.75	1,785.00
Riprap, hand placed, do	1.25	400.00	2.00	640.00	2.50	800.00
Piles in permanent construction, linear feet	.15	8,250.00	.25	13,750.00	.27½	15,125.00
Timber in permanent construction, feet, B. M.	30.00	4,200.00	24.00	3,360.00	33.00	4,620.00
Bolt holes in masonry, linear feet	.20	20.00	1.00	100.00	.50	50.00
Total	.....	75,010.30	.....	79,632.00	.....	88,528.50

List of civilian engineers employed on work of river and harbor improvements in charge of Missouri River Commission from July 1, 1894, to June 30, 1895, inclusive, under the river and harbor acts of September 19, 1890, July 13, 1892, March 3, 1893, August 18, 1894, and March 2, 1895 (improving Missouri River from its mouth to Sioux City, Iowa), and acts of September 19, 1890, July 13, 1892, and August 17, 1894 (improving Osage River, Missouri and Kansas), and acts of July 13, 1892, and August 17, 1894 (improving Gasconade River, Missouri).

Name and residence.	Time employed.		Compensation per month.	Where employed.
	Mos.	*dys.*		
Samuel H. Yonge, Jefferson City, Mo	12	0	$250.00	Osage City, Mo., first reach, Osage division.
S. Waters Fox, Gasconade, Mo	12	0	250.00	Gasconade, Mo., first reach, Gasconade division.
O. B. Wheeler, St. Louis, Mo	12	0	200.00	St. Louis, Mo.
J. A. Seddon, St. Louis, Mo	12	0	200.00	Do.
A. H. Blaisdell, St. Louis, Mo	10	15	200.00	Do.
Theo. Schoonmaker, St. Louis, Mo	6	0	200.00	Do.
C. M. Winchell, St. Louis, Mo	8	21	175.00	Do.
	1	10	175.00	In the field.*
R. H. Bacot, Osage City, Mo	6	27	150.00	Osage City, Mo., first reach, Osage division.
A. N. Darrow, St. Louis, Mo	1	0	150.00	St. Louis, Mo.
J. W. Beaman, Jefferson City, Mo	2	0	150.00	Osage River.
J. C. Meredith, Council Bluffs, Iowa	0	15	150.00	Gasconade, Mo., first reach, Gasconade division.
	2	16	175.00	St. Louis, Mo.
	1	18	212.50	Special survey (includes subsistence).*
	1	7	200.00	Atchison, Kans.
	1	13	200.00	Omaha, Nebr.
	1	18	200.00	St. Joseph, Mo.
	0	22	200.00	Leavenworth, Kans.
O. H. B. Turner, St. Louis, Mo	3	0	137.50	St. Louis, Mo.
L. P. Butler, St. Louis, Mo	6	14	.....	Do.
	2	10	125.00	Gasconade River, Mo.
	0	6	150.00	In the field (includes subsistence.)†
A. H. Weber, Osage City, Mo	9	20	125.00	Osage City, Mo., first reach, Osage division.
R. A. Crawford, Osage City, Mo	1	0	125.00	Do.
W. R. De Witt, Gasconade, Mo	8	16	125.00	Gasconade, Mo., first reach, Gasconade division.

*On survey of Missouri River.

†On survey of Gasconade River.

List of civilian engineers employed on work of river and harbor improvements in charge of Missouri River Commission, etc.—Continued.

Name and residence.	Time employed.	Compensation per month.	Where employed.
	Mos. dys.		
Ed. Jones, Gasconade, Mo	0 15	90.00	Gasconade, Mo., first reach, Gasconade division.
	9 21	125.00	
V. Schindler, St. Louis, Mo	12 0	125.00	St. Louis, Mo.
B. Smith, Leavenworth, Kans	2 4	125.00	Atchison, Kans.
	1 10	125.00	Leavenworth, Kans.
Wm. H. Floyd, St. Joseph, Mo	2 8	125.00	St. Joseph, Mo.
A. B. Ross, Omaha, Nebr	2 0	125.00	Omaha, Nebr.
J. Wm. Link, St. Louis, Mo	3 0	110.00	St. Louis, Mo.
E. D. Williams, St. Louis, Mo	1 0	100.00	Do.

APPENDIX A.

REPORT ON COMMERCE OF MISSOURI RIVER DURING CALENDAR YEAR 1894.

OFFICE MISSOURI RIVER COMMISSION,
St. Louis, Mo., June 30, 1895.

SIR: I have the honor to submit the following report on the commerce of the Missouri River between Sioux City and the mouth during the calendar year 1894:

These statistics, in order to be comparable with those of former years, were made to cover all that portion of the river below the mouth of the Big Sioux River, thus including the business of the port of Sioux City; but footnotes under the tables show what portion of the trade did not pass below the south limits of Sioux City.

The methods employed in obtaining these statistics were similar to those used in obtaining the statistics for 1893. Lists were first obtained from the surveyors of customs at St. Louis, Mo., Kansas City, Mo., St. Joseph, Mo., Omaha, Nebr., Burlington, Iowa, Nashville, Tenn., and Rock Island, Ill., giving the names of all steamboats enrolled at those points in 1894 and plying on the Missouri River between Sioux City and the mouth in that year; also the names and addresses of owners and various detailed information about the boats, all of which is included in Tables 5 to 11.

On February 18, 1895, special blanks, covering almost every article of freight, with explanatory circulars, were sent out to all boat owners and others engaged in transportation on the river with a request that the blanks be filled out and returned to this office. Much additional correspondence and, in some cases, personal interviews with the boat owners were necessary before all the data were collected and in shape to place in tabular form for comparison with the statistics of previous years.

The following table, giving the amount of freight carried, towed, and rafted, together with the number of passengers carried, in 1894, is believed to be a close approximation to the actual trade, though, owing to the great length of river covered and the difficulty of securing the details of the business of the smaller boats, it is probably somewhat under the actual amount carried:

TABLE 1.

Class.	Grain.	Live stock.	Wood and lumber.	Sand and building material.	Miscellaneous farm produce and general merchandise.	Total.	Mile-tons.	Passengers.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*		*No.*
Long-trade packets	4,551.7	670.8	189.2	97.2	3,112.7	8,621.6	1,055,525.6	3,150
Short-trade packets and miscellaneous boats	20,450.6	2,302.1	9,599.0	10,462.9	4,015.1	46,829.7	729,862.4	*3,312
Sand and wood steamers and barges	.....	.....	329.8	95,243	.....	95,572.8	156,346	.....
Rafts	.....	.....	3,310.7	.....	.....	3,310.7	141,850.1	.....
Total	25,002.3	2,972.9	13,428.7	105,803.1	7,127.8	154,334.8	2,073,584.1	6,462

*Including 1,000 excursion passengers, 533 of which were above the southern limits of Sioux City, Iowa.

The following comparative table gives the totals for the different classes of trade for the years 1891–1894:

TABLE 2.

Class.	Total number of tons carried.			
	1894.	1893.	1892.	1891.
Long-trade packets	8,621.6	19,310.9	30,372.3	31,458.4
Short-trade packets and miscellaneous boats	46,829.7	73,248.5	110,449.1	73,866.3
Sand and wood steamers and barges	95,572.8	146,827.9	91,092.6	71,103.3
Rafts	3,310.7	10,578	4,908.9	8,118.1
Total	154,334.8	249,965.3	236,872.9	189,546.1

Class.	Mile-tons.				Passengers.			
	1894.	1893.	1892.	1891.	1894.	1893.	1892.	1891.
Long-trade packets	1,055,525.6	4,093,147.3	6,112,179.6	6,437,472.8	3,150	3,700	4,450	6,000
Short-trade packets and miscellaneous boats	729,862.4	758,604.2	1,411,529.6	1,455,627.6	*3,312	†8,532	‡41,823	8,000
Sand and wood steamers and barges	156,346	235,998.3	327,561.7	145,868.7	.....	.....	.....	.....
Rafts	141,850.1	579,215.3	522,700.8	158,262.3	.....	.....	.....	.....
Total	2,073,584.1	5,666,965.1	8,373,971.7	8,197,231.4	6,462	12,232	46,273	14,000

* Including 1,000 excursion passengers, 533 of which were above the southern limits of Sioux City, Iowa.

† Including 6,200 excursion passengers.

‡ Including 34,693 excursion passengers.

From Table 2 it is seen that the river trade during 1894 was considerably smaller than in the three preceding years.

This decrease appears to have been general on all the rivers whose trade is tributary to St. Louis.

In the case of the Missouri the decrease appears to be due to the withdrawal from business of the Kansas City and Missouri River Transportation Company, to the completion of the Missouri, Kansas, and Eastern Railway (skirting the north bank from near the mouth to Boonville, Mo.), and to the general business depression. The boats of the first-named company have formed the only line since 1888 running from St. Louis to Kansas City. Two boats of this company have in previous years, since 1890, been in service on this route. One of these, the *State of Kansas*, was sold about May 20, 1893, for use on the Lower Mississippi, and the other, the *A. L. Mason*, was sunk in the Lower Mississippi January 5, 1894. The only other boat belonging to this company, the *State of Missouri*, which has never run on the Missouri, was sold in the summer of 1893.

The following table gives the number and total registered tonnage of steamboats plying on the Missouri River for the years 1889–1894:

TABLE 3.

Enrolled at—	1894.		1893.		1892.	
	No.	Tons.	No.	Tons.	No.	Tons.
St. Louis, Mo	17	1,445.54	20	2,282.49	24	2,562.78
Kansas City, Mo	7	562.03	11	2,932.42	12	2,980.08
St. Joseph, Mo	3	47.50	3	47.50	3	148.88
Omaha, Nebr	*12	866.72	11	911.99	11	912.29
St. Paul, Minn	.....	.....	.....	.....	1	324.09
Dubuque, Iowa	.....	.....	1	58.32	1	58.32
New Orleans, La	.....	.....	.....	.....	1	358.31
Burlington, Iowa	1	340.49	2	450.84	.....	.....
Cincinnati, Ohio	.....	.....	1	134.92	.....	.....
Nashville, Tenn	1	172.76	.....	.....	.....	.....
Rock Island, Ill	1	188.59	.....	.....	.....	.....
Total	42	3,623.63	49	6,818.48	53	7,344.75

* Ten of these, with a tonnage of 833.01 tons, did not go below the southern limits of Sioux City, Iowa.

TABLE 3—Continued.

Enrolled at—	1891.		1890.		1889.	
	No.	Tons.	No.	Tons.	No.	Tons.
St. Louis, Mo	19	2,504.31	18	1,840.61	16	1,812.66
Kansas City, Mo	18	3,398.13	17	1,270.33	15	1,626.26
St. Joseph, Mo	5	265.41	5	277.62	5	277.62
Omaha, Nebr	12	794.21	10	504.72	13	1,329.85
Louisville, Ky	.....	.....	1	1,130.34	.....	.....
Total	54	6,962.06	51	5,023.62	49	5,046.09

Five gasoline boats, not subject to Government inspection, were also engaged in trade on the river below Sioux City during the year 1894. The aggregate amount of freight carried by them was about 1,107 tons, which amount is included in Table 1.

The gauge observers under the Commission record and report weekly the number and names of steamboats (including gasoline boats) passing their respective stations. From these reports and from the known tonnage of the steamboats and estimated tonnage of the gasoline boats, the following table for six of the gauge stations is made up:

TABLE 4.

Locality.	Number of steamers passed.		Registered tonnage.	
	Up.	Down.	Up.	Down.
St. Charles	39	40	13,023.90	12,905.13
Coles Creek (3.6 miles above Hermann)	228	227	21,228.69	21,002.59
Ewings (7.5 miles below Jefferson City)	98	97	15,152.26	14,902.22
Boonville	72	72	5,841.18	5,750.51
Kansas City	2	1	161.88	136.88
Sioux City	3	2	88.42	43.42

Rates of insurance on the river have remained unchanged since July, 1889. They are believed to be higher than on any other river comparable in size with the Missouri.

No new line of transportation has been established during the fiscal year 1894–95.

TABLE 5.—*List of steamers plying on the Missouri River, in the district of New Orleans, enrolled or licensed at the port of St. Louis, Mo., during the year 1894.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.
				Length.	Breadth.	Depth.	
				Feet.	*Feet.*	*Feet.*	
Annie Dell	Hermann, Mo	1889	May 8, 1894	70	16.6	2	19.05
A. W. Ewing	Osage City, Mo	1878	do	.....	.....	.....	†4.00
Benton	Pittsburg, Pa	1875	Aug. 3, 1894	197	33	5	394.08
Black Diamond	Portland, Mo	1885	June 26, 1894	72.5	14.4	2.3	18.40
Commodore	New Haven, Mo	1890	July 3, 1894	97	23.2	3.2	86.45
Edna	Boonville, Mo	1887	May 9, 1894	102.4	21.5	4.2	80.35
Fawn	Hermann, Mo	1880	May 4, 1894	91.8	19.1	3.4	73.94
Frederick	Tuscumbia, Mo	1883	June 27, 1894	96.4	14.3	3	82.51
Gasconade	Hermann, Mo	1891	July 7, 1894	107.4	23.9	3.5	74.35
G. M. Sivley	Le Claire, Iowa	1893	Sept. 13, 1894	123.5	24	4.6	98.94
John L. Ferguson*	Grafton, Ill	1876	Oct. 27, 1893	111.6	26.6	3.6	79.81
John R. Hugo	Evansville, Ind	1879	May 8, 1894	127	20	3	136.88
May Bryan	Jeffersonville, Ind	1875	Nov. 22, 1894	115	28	4.5	97.40
Mill Boy	Hermann, Mo	1893	Feb. 9, 1894	89.2	18.8	2.8	41.10
Peerless	do	1894	Mar. 8, 1894	96.6	21.4	3.5	50.41
Pin Oak	do	1888	May 8, 1894	95	17.5	2.2	43.05
Royal	do	1884	do	86.6	24	3	44.82

*Condemned October 25, 1894.

TABLE 5.—*List of steamers plying on the Missouri River, in the district of New Orleans, enrolled or licensed at the port of St. Louis, Mo., etc.*—Continued.

Name.	Staterooms.	Berths.	Passengers.			Engines.			Boilers.				
			Permitted to carry.	First cabin.	Steerage or deck.	Number.	Diameter.	Stroke.	Number.	Length.	Diameter.	Flues.	
												Number.	Diameter.
							In.	*Ft.*		*Ft.*	*In.*		*In.*
Annie Dell	.....	.....	25	.....	25	2	6	2	1	10	36	†14	3, 3½
A. W. Ewing	.....	.....	8	.....	8	1	6	⅔	1	3	40	†70	1¼
Benton	18	36	66	30	36	2	15½	5	3	24	38	6	15½
Black Diamond	.....	.....	10	.....	10	2	6	3	1	14	30	‡21	3
Commodore	.....	.....	50	.....	50	2	10	4	1	20	40	6	4-6 2-12
Edna	6	12	22	2	20	2	8	3⅓	1	14	44	10	6
Fawn	.....	.....	50	.....	50	2	8	2	1	14	42	4	2-10 2-12
Frederick	4	13	28	13	15	2	7	2½	1	14	36	6	6
Gasconade	3	6	35	5	30	2	9	3½	1	20	42	5	6, 10
G. M. Sivley	7	14	60	10	50	2	12¼	5	2	24	32	10	6
John L. Ferguson *	.....	.....	20	.....	20	2	11	4	1	16	42	12	5
John R. Hugo	6	9	39	9	30	2	12½	3½	1	24	42	5	10
May Bryan	.....	.....	50	.....	50	1	16	5	1	22	44	5	2-10 3-12
Mill Boy	.....	.....	20	.....	20	2	8	1	1	14	44	1 †26	24 3
Peerless	2	4	22	.....	22	2	8	3	1	16	42	2 †36	15 3
Pin Oak	.....	.....	20	.....	20	2	8	2½	1	17	40	†36	3
Royal	.....	.....	20	.....	20	2	8	2⅓	1	12	36	5	7

Name.	Boilers.			Licensed to run on—	Name and address of sole or managing owner.
	Steel or iron.	When built.	Steam pressure allowed.		
			Lbs.		
Annie Dell	Steel..	1889	130	Mississippi and tributary rivers.	Wm. L. Heckmann, Mount Sterling, Mo.
A. W. Ewing	Steel..	1885	125	.....do	C. C. Turner, Osage City, Mo.
Benton	Iron ..	1875	125	.....do	H. C. Harkins, St. Louis, Mo.
Black Diamond	Steel..	1886	130	.....do	L. L. Kurtzebaum, Carthage, Mo.
Commodore	Steel..	1890	153	.....do	D. N. Burruss, Miami, Mo.
Edna	Steel..	1887	160	.....do	L. C. Lohman, Jefferson City, Mo.
Fawn	Iron ..	1877	110	.....do	Chas. Able, St. Charles, Mo.
Frederick	Steel..	1883	150	.....do	R. M. Marshall, Tuscumbia, Mo.
Gasconade	Steel..	1891	160	.....do	Hermann Ferry and Packet Co., Hermann, Mo.
G. M. Sivley	Steel..	1893	199	.....do	G. M. Sivley, Havana, Ill.
John L. Ferguson *	Iron ..	1864	91	Missouri River, 5 miles above and below Jefferson City, Mo.	Cole & Calloway Transportation Co., Jefferson City, Mo.
John R. Hugo	Steel..	1894	160	Mississippi and tributary rivers.	R. M. Marshall, Tuscumbia, Mo.
May Bryan	Iron ..	1875	113	Missouri River between St. Charles and 10 miles above Hermann, Mo.	Washington Ferry Co., Washington, Mo.
Mill Boy	Steel..	1893	110	Mississippi and tributary rivers.	Hermann Ferry and Packet Co., Hermann, Mo.
Peerless	Steel..	1894	160	.....do	Do.
Pin Oak	Steel..	1888	125	.....do	E. W. Wild, Hermann, Mo.
Royal	Steel..	1884	125	.....do	H. F. Jones, Neosho, Mo.

* Condemned October 25, 1894. † Estimated. ‡ Tubes.

TABLE 6.—*List of steamers plying on the Missouri River, in the district of New Orleans, enrolled or licensed at the port of Kansas City, Mo., during the year 1894.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.
				Length.	Breadth.	Depth.	
				Feet.	*Feet.*	*Feet.*	
Alda	Boonville, Mo.	1891	May 21, 1894	121	21.2	4	73.80
Annie Cade	Leavenworth, Kans.	1879	May 23, 1894	127.5	32	4.5	178.32
Belle of Brownville	Grafton, Ill.	1880	do	110	30	4	102.44
Jos. L. Stevens	Jeffersonville, Ind.	1887	May 21, 1894	103	29.4	4.2	85.95
Plow Boy	Sioux City, Iowa	1884	do	77.7	21.4	5.6	29.32
Roy Lynds	Jeffersonville, Ind.	1887	May 22, 1894	87	25	3.6	64.19
St. Elmo	De Witt, Mo.	1891	May 21, 1894	57	17.4	3	28.01

Name.	Staterooms.	Berths.	Passengers.			Engines.			Boilers.				
			Permitted to carry.	First cabin.	Steerage or deck.	Number.	Diameter.	Stroke.	Number.	Length.	Diameter.	Flues.	
												Number.	Diameter.
							In.	*Ft.*		*Ft.*	*In.*		*In.*
Alda	6	12	58	8	50	2	10	5	1	22	42	10	6
Annie Cade	.....	.....	.....	.....	.....	1	$20\frac{5}{8}$	$5\frac{1}{2}$	2	16	42	.....	.....
Belle of Brownville	.....	.....	.....	.....	.....	1	16	4	1	18	48	.....	.....
Jos. L. Stevens	.....	.....	.....	.....	.....	2	10	$3\frac{1}{2}$	1	16	48	.....	.....
Plow Boy	.....	.....	10	.....	10	2	8	2	1	14	40	40	3
Roy Lynds	.....	.....	.....	.....	.....	2	9	3	1	18	42	.....	.....
St. Elmo	.....	.....	25	.....	25	2	7	3	1	12	40	7	6

Name.	Boilers.			Licensed to run on—	Name and address of sole or managing owner.
	Steel or iron.	When built.	Steam pressure allowed.		
			Lbs.		
Alda	Steel	1891	153	Mississippi and tributary rivers.	John Mackler, Boonville, Mo.
Annie Cade	Iron	1879	119	Missouri River at Kansas City, 5 miles above and below.	Wm. A. Cade, Kansas City, Mo.
Belle of Brownville	Steel	1880	140	Missouri River at ferry crossings.	J. W. Morgan, Leavenworth, Kans.
Jos. L. Stevens	Steel	1887	125	do	Jos. L. Porter, Boonville, Mo.
Plow Boy	Steel	1889	150	Mississippi and tributary rivers.	D. N. Smith, Boonville, Mo.
Roy Lynds	Steel	1887	161	Mississippi River at Lexington, Mo.	Lexington Coal, Ferry and Transportation Co., Lexington, Mo.
St. Elmo	Steel	1891	130	Mississippi and tributary rivers.	O. J. Miller, Nevada, Mo.

TABLE 7.—*List of steamers plying on the Missouri River, in the district of New Orleans, enrolled or licensed at the port of St. Joseph, Mo., during the year 1894.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.
				Length.	Breadth.	Depth.	
				Feet.	*Feet.*	*Feet.*	
Bee	St. Joseph, Mo	1893	June 12, 1894	53.5	13.5	3.5	16.42
Harry Lynds	White Cloud, Kans	1892	Mar. 27, 1894	64	18	3	27.08
Princess	St. Joseph, Mo	1889	Aug. 28, 1894	.....	.....	.....	*4

Name.	Staterooms.	Berths.	Passengers.			Engines.			Boilers.				
			Permitted to carry.	First cabin.	Steerage or deck.	Number.	Diameter.	Stroke.	Number.	Length.	Diameter.	Flues.	
												Number.	Diameter.
							In.	*Ft.*		*Ft.*	*In.*		*In.*
Bee	.....	.....	10	.. ..	10	1	8	1	1	$11\frac{5}{6}$	34	†28	3
Harry Lynds	.....	.....	20	.....	20	1	7	$\frac{5}{6}$	1	7	30	1	12
												†13	3
Princess	.....	.....	16	.....	16	1	$4\frac{1}{2}$	$\frac{5}{12}$	1	3	24	.....	.....

*Estimated. †Tubes.

Name.	Boilers.			Licensed to run on—	Name and address of sole or managing owner.
	Steel or iron.	When built.	Steam pressure allowed.		
			Lbs.		
Bee	Steel	1887	120	Missouri and tributary rivers.	Henry W. Dunn, St. Joseph, Mo.
Harry Lynds	Iron	1883	120	Missouri River at White Cloud, Kans.	J. H. Lynds, White Cloud, Kans.
Princess	Steel	1891	120	Missouri River at St. Joseph, Mo.	W. E. Jamieson, St. Joseph, Mo.

TABLE 8.—*List of steamers plying on the Missouri River, in the district of New Orleans, enrolled or licensed at the port of Omaha, Nebr., during the year 1894.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.
				Length.	Breadth.	Depth.	
				Feet.	*Feet.*	*Feet.*	
Andrew S. Bennett*	Sioux City, Iowa	1880	May 15, 1894	115.0	30.0	3.5	78.08
Capitola Butt*	Montrose, Iowa	1885	June 13, 1894	83.7	23.3	3.3	57.03
Castalia*	Sioux City, Iowa	1892	.....	110.0	26.0	3.7	90.06
Flora*	Waukegan, Ill	1888	June 12, 1894	.....	.....	.....	†4.00
Josie L. K*	Chamberlain, S. Dak	1884	Aug. 30, 1894	60.0	14.0	2.5	22.75
Last Chance*	Burlington, Iowa	1870	May 19, 1894	98.2	17.8	3.0	50.47
Little Maud*	Sioux City, Iowa	1882	July 13, 1894	92.0	20.0	3.4	58.66
Mary E. Bennett	Covington, Nebr	1888	Aug. 30, 1894	65.0	14.0	2.5	21.71
Minnehaha*	Canton, S. Dak	1893	Aug. 29, 1894	.....	.....	.....	†8.00
Queen No. 2	Tieville, Iowa	1879	.....do.....	44.0	12.0	2.0	12.00
Rosebud*	Pittsburg, Pa	1877	.....	177.4	31.3	4.0	286.49
Vint Stillings*	Metropolis, Ill	1881	July 11, 1894	131.0	31.6	4.8	177.47

* Did not go below southern limits of Sioux City, Iowa. † Estimated.

TABLE 8.—*List of steamers plying on the Missourri River, in the district of New Orleans, enrolled or licensed at the port of Omaha, Nebr., etc.*—Continued.

Name.	Staterooms.	Berths.	Passengers.			Engines.			Boilers.				
			Permitted to carry.	First cabin.	Steerage or deck.	Number.	Diameter.	Stroke.	Number.	Length.	Diameter.	Flues.	
												Number.	Diameter.
							In.	*Feet.*		*Ft.*	*In.*		*In.*
Andrew S. Bennett*	.....	.....	75	.....	75	2	11½	4½	1	22	48	6	2–14 4–7½
Capitola Butt*	.....	.....	20	.....	20	2	11	3½	1	20	46	10	7
Castalia*	6	12	22	7	15	2	10	4	1	20	42	6	4–6 2–10
Flora*	.....	.....	15	.....	15	1	4½	1 5/12	1	4	24	†33	2
Josie L. K.*	.....	.....	30	.....	30	1	6	1	1	6¾	42	†52	2½
Last Chance*	.....	.....	32	2	30	2	11	3	1	18	42	4	2–8 2–10
Little Maud*	.....	.....	.....	.....	.....	2	10½	3	1	24	40	.....	.....
Mary E. Bennett	.....	.....	10	.....	10	2	7¼	2 5/6	1	16	38	5	8
Minnehaha*	.....	.....	40	.....	40	1	4	5	1	6	24	†31	2
Queen No. 2	.....	.....	.....	.....	.....	1	7¼	⅔	1	7½	30	.....	.....
Rosebud*	11	20	23	23	.....	2	13⅛ 13¼	5	2	24	45	10	9
Vint Stillings*	.....	.....	37	.....	37	2	20	5	2	22	42	5	10

Name.	Boilers.			Licensed to run on—	Name and address of sole or managing owner.
	Steel or iron.	When built.	Steam pressure allowed.		
			Lbs.		
Andrew S. Bennett*	Steel..	1883	140	Missouri and tributary rivers.	Wm. Luther, Covington, Nebr.
Capitola Butt*	Steel..	1885	135	.....do	R. A. Talbot, Covington, Nebr.
Castalia*	Steel..	1892	160	.....do	B. S. Holmes, Sioux City, Iowa.
Flora*	Steel..	1888	100	Big Sioux and Floyd rivers and Missouri River between the two.	Albert Heller & Bro., Sioux City, Iowa.
Josie L. K.*	Steel..	1888	120	Missouri River	Yankton Bridge and Ferry Co., Yankton, S. Dak.
Last Chance*	Iron ..	1870	83	.....do	M. R. King, Chamberlain, S. Dak.
Little Maud*	Steel..	1889	156	Missouri River between Niobrara and Fort Randall.	Jos. Leach, Running Water, S. Dak.
Mary E. Bennett	Steel..	1891	140	Mississippi and tributary rivers.	R. A. Talbot, Covington, Nebr.
Minnehaha*	Steel..	1894	120	Floyd and Big Sioux rivers.	J. W. Clairidge, Sioux City, Iowa.
Queen No. 2	Iron ..	1877	110	Missouri River at ferry crossings.	Anderson, Kilbourn & Co., Decatur, Nebr.
Rosebud*	Steel..	1882	149	Mississippi and tributary rivers.	Sioux City Packet Co., Sioux City, Iowa.
Vint Stillings*	Iron ..	1878	125	Missouri River at Sioux City.	Selzer Bros., Sioux City, Iowa.

* Did not go below southern limits of Sioux City, Iowa.

† Tubes.

TABLE 9.—*List of steamers plying on the Missouri River, in the district of New Orleans, enrolled or licensed at the port of Burlington, Iowa, during the year 1894.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.
				Length.	Breadth.	Depth.	
				Feet.	*Feet.*	*Feet.*	
John Bertram	Jeffersonville, Ind.	1880		180	34	5	390.49

Name.	Staterooms.	Berths.	Passengers.			Engines.			Boilers.				
			Permitted to carry.	First cabin.	Steerage or deck	Number.	Diameter.	Stroke.	Number.	Length.	Diameter.	Flues.	
												Number.	Diameter.
							In.	*Ft.*		*Ft.*	*In.*		*In.*
John Bertram						2	20	$6\frac{1}{2}$	4	24	38		

Name.	Boilers.			Licensed to run on—	Name and address of sole or managing owner.
	Steel or iron.	When built.	Steam pressure allowed.		
			Lbs.		
John Bertram	Iron	1880	150	Mississippi and tributary rivers.	St. Louis, Keokuk and Northwestern Railway.

TABLE 10.—*List of steamers plying on the Missouri River, in the district of New Orleans, enrolled or licensed at the port of Nashville, Tenn., during the year 1894.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.
				Length.	Breadth.	Depth.	
				Feet.	*Feet.*	*Feet.*	
J. J. Odil	Nashville, Tenn.	1889	Dec. 22, 1893	149.5	28.5	3.0	172.76

Name.	Staterooms.	Berths.	Passengers.			Engines.			Boilers.				
			Permitted to carry.	First cabin.	Steerage or deck.	Number	Diameter.	Stroke.	Number.	Length.	Diameter.	Flues.	
												Number.	Diameter.
							In.	*Feet.*		*Ft.*	*In.*		*Inches.*
J. J. Odil	20	40	40	30	10	2	10	$3\frac{1}{2}$	2	14	36	18	5

TABLE 10.—*List of steamers plying on the Missouri River, in the district of New Orleans, enrolled or licensed at the port of Nashville, Tenn., etc.*—Continued.

Name.	Boilers.			Licensed to run on—	Name and address of sole or managing owner.
	Steel or iron.	When built.	Steam pressure allowed.		
			Lbs.		
J. J. Odil.....	Steel..	1889	175	Mississippi and tributary rivers.	Louis Rosche, St. Louis, Mo.

TABLE 11.—*List of steamers plying on the Missouri River, in the district of New Orleans, enrolled or licensed at the port of Rock Island, Ill., during the year 1894.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.
				Length.	Breadth.	Depth.	
				Feet.	*Feet.*	*Feet.*	
J. W. Spencer.....	Jeffersonville, Ind....	1882	May 28, 1894	131.0	35.0	5.0	188.59

Name.	Staterooms.	Berths.	Passengers.			Engines.			Boilers.				
			Permitted to carry.	First cabin.	Steerage or deck.	Number.	Diameter.	Stroke.	Number.	Length.	Diameter.	Flues.	
												Number.	Diameter.
							In.	*Feet.*		*Ft.*	*In.*		*Inches.*
J. W. Spencer.....	.....	.....	.....	.....	.....	2	16	6	2	26	40	4	16

Name.	Boilers.			Licensed to run on—	Name and address of sole or managing owner.
	Steel or iron.	When built.	Steam pressure allowed.		
			Lbs.		
J. W. Spencer.....	Steel..	1882	150	Missouri River 100 miles above and below Jefferson City, Mo.	Cole & Calloway Transportation Co., Jefferson City, Mo.

Very respectfully, your obedient servant,

J. C. SANFORD,
First Lieut. of Engineers, Secretary.

Lieut. Col. CHAS. R. SUTER,
Corps of Engineers, U. S. A.,
President Missouri River Commission.

APPENDIX B.

REPORT ON COMMERCE OF OSAGE RIVER DURING CALENDAR YEAR 1894.

OFFICE MISSOURI RIVER COMMISSION,
St. Louis, Mo., June 30, 1895.

SIR: I have the honor to submit the following report on the commerce of Osage River during the calendar year 1894:

The methods employed in securing the statistics were the same as those employed on the Missouri River, viz, by circular letters and blanks sent to boat owners and others engaged in river trade.

The Commission not having assumed the charge of the river until January 15, 1895, I did not have the assistance which the weekly commerce reports of the gauge observers will hereafter afford in checking up the statistics, and therefore have relied solely on the statements sent me in answer to my circular letters. Most of these letters brought forth satisfactory answers, but in a few instances an estimate based on a comparison with other shipments became necessary.

The larger part of the steamboat trade was between Tuscumbia and the mouth, a distance of 60 miles; the *Annie Dell*, however, ran up as far as Linn Creek, about 109 miles from the mouth, and a smaller boat, the *Black Diamond*, plied solely in the upper river, within 35 miles above and below Osceola, Mo. (about 229 miles above the mouth).

There are a large number of sawmills in the upper river to which were rafted a considerable amount of logs, the finished product of which was mostly shipped by rail. The distances which these logs were rafted could not in all cases be satisfactorily obtained as they were gathered up at a number of points on the river.

The following table giving the amount of freight carried, towed, and rafted, not including any ferry business, is presented as a close approximation to the actual trade:

TABLE 1.

Class.	Grain.	Live stock.	Wood and lumber.	Railroad ties.	Building material.	Sand and gravel.	Barytes.	Salt.	Produce.	Farm machinery and general merchandise.	Total.	Mile-tons.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	
Packets and miscellaneous boats.	4,793	1,076	2,140	.....	60	8,100	440	128	186	1,356	18,279	434,192
Rafts	.....	.....	13,585	73,361	.....	.....	.....	.....	.....	.....	86,946	4,169,429
Total	4,793	1,076	15,725	73,361	60	8,100	440	128	186	1,356	105,225	4,603,621

The following comparative table gives the totals for the different classes of freight carried during the years 1890-1894, but with the mile-tons omitted, data to obtain which were gathered only in 1894:

TABLE 2.

Articles.	Tons carried.				
	1894.	1893.	1892.	1891.	1890.
Hay, grain, etc	4,793	3,773	5,471	6,135	5,118
Lumber, logs, wood, railroad ties, etc	89,086	62,020	69,721	77,195	86,349
Live stock	1,076	741	739	957	766
Produce	186	196	182	527	319
Salt	128	329	281	602	482
Barytes	440	470	1,200	2,775	1,710
General merchandise, farm machinery, etc	1,416	946	1,686	2,858	2,269
Gravel	8,100	.....	.....	.....	.....
Total	105,225	68,475	79,280	91,049	97,013

It will be seen by the above table that the trade in 1894 shows a considerable increase over that in 1893.

Most of this increase appears in the item of railroad ties, in which a very large trade is done yearly. The gravel business carried on near Osceola, Mo., does not appear to have been included in former reports. The table, however, shows a satisfactory increase in shipments of grain and live stock over that in 1893.

Full particulars regarding the steam vessels which were engaged in trade on the river during 1894 is given in the following table:

TABLE 3.—*List of steamers plying on the Osage River, in the district of New Orleans, enrolled at the port of St. Louis, Mo., during the year 1894.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.	Staterooms.	Berths.	Passengers.		
				Length.	Breadth.	Depth.				Permitted to carry.	First cabin.	Steerage or deck.
				Feet.	*Feet.*	*Feet.*						
Annie Dell*	Hermann, Mo	1889	May 8, 1894	70	16.6	2	19.05	...	...	25	...	25
A. W. Ewing‡	Osage City, Mo.	1878	do	...	...	...	4	...	...	8	...	8
Benton‡	Pittsburg, Pa	1875	Aug. 3, 1894	197	33	5	394.08	18	36	66	30	36
Black Diamond‡	Portland, Mo	1885	June 26, 1894	72.5	14.4	2.3	18.40	...	...	10	...	10
Edna‡	Boonville, Mo	1887	May 9, 1894	102.4	21.5	4.2	80.35	6	12	22	2	20
Frederick‡	Tuscumbia, Mo.	1883	June 27, 1894	96.4	14.3	3	82.51	4	13	28	13	15
John R. Hugo‡	Evansville, Ind.	1879	May 8, 1894	127	20	3	136.88	6	9	39	9	30
Urie*	Osceola, Mo	1890	June 26, 1894	88	20.2	3.1	44.55	...	...	....	....	....

Name.	Engines.			Boilers.							Name and address of sole or managing owner.
							Flues.		When built.	Steam pressure allowed.	
	Number.	Diameter.	Stroke.	Number.	Length.	Diameter.	Number.	Diameter.			
		In.	*Ft.*		*Ft.*	*In.*		*Inches.*			
Annie Dell*	2	6	2	1	10	36	†14	3 and $3\frac{1}{2}$	1889	130	W. L. Heckmann, Mount Sterling, Mo.
A. W. Ewing‡	1	6	$\frac{8}{12}$	1	3	40	†70	$1\frac{1}{4}$	1885	125	C. C. Turner, Osage City, Mo.
Benton‡	2	$15\frac{1}{2}$	5	3	24	38	6	$15\frac{1}{2}$	1875	125	H. C. Harkins, St. Louis, Mo.
Black Diamond‡	2	6	3	1	14	30	†21	3	1886	130	L. L. Kurtzebaum, Carthage, Mo.
Edna‡	2	8	$3\frac{4}{12}$	1	14	44	10	6	1887	160	L. C. Lohman, Jefferson City, Mo.
Frederick‡	2	7	$2\frac{1}{2}$	1	14	36	6	6	1883	150	R. M. Marshall, Tuscumbia, Mo.
John R. Hugo‡	2	$12\frac{1}{2}$	$3\frac{1}{2}$	1	24	42	5	10	1894	160	Do.
Urie*	1	10	$1\frac{1}{6}$	1	$13\frac{1}{2}$	42	†36	3	1890	120	M. J. Wright, Osceola, Mo.

* Licensed to run on Osage River. † Tubes. ‡ Licensed to run on Mississippi and tributary rivers.

It will be noticed that the steamer *Benton*, a Missouri River long-trade packet, is included in this list. She entered the river a few times during high water and went up as far as Tuscumbia. The total amount of her freight, however, was only about 125 tons, the remainder of the frieght having been carried on boats built primarily for and mostly engaged in the Osage and Gasconade river trades.

Two small gasoline boats were also on the river in 1894, but did no business except ferriage, which is not included in this report.

Very respectfully, your obedient servant,

J. C. SANFORD,
First Lieut. of Engineers, Secretary.

Lieut. Col. CHAS. R. SUTER,
Corps of Engineers, U. S. A.,
President Missouri River Commission.

APPENDIX C.

REPORT ON COMMERCE OF GASCONADE RIVER DURING CALENDAR YEAR 1894.

OFFICE MISSOURI RIVER COMMISSION,
St. Louis, Mo., June 30, 1895.

SIR: I have the honor to submit the following report on the commerce of the Gasconade River during the calendar year 1894:

The same method of securing the statistics was employed on this river as had previously been adopted on the Missouri River, viz, sending out early in the year blanks covering every probable variety of freight carried, accompanied by an explanatory circular letter, to boat owners and all others engaged in river trade.

For the most part satisfactory answers were received; but in some cases the distances that the freight was carried and the logs and ties rafted could not be accurately determined, and for these the distances used in obtaining the mile-tons were estimated.

Some of the steamers were engaged in trade as far up as Vienna, 78 miles above the mouth; but the greater part of the business done by steamboats appears to have been carried on in the lower 45 miles of the river.

Some of the rafts and railroad ties have come from the mouth of Big Piney Creek, 110 miles above the mouth of the Gasconade, and possibly from still farther up. These distances as given were scaled from the maps of the river, and are nearly 30 per cent less than the distances given by the local steamboat owners.

The following table, giving the amount of freight carried, towed, and rafted in 1894, not including any ferry business, is presented as a close approximation to the actual business done on the river:

TABLE 1.

Class.	Grain.	Live stock	Wood and lumber.	Railroad ties.	Building material.	Sand and gravel.	Salt.	Produce.	Farm machinery and general merchandise.	Total.	Mile-tons.
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	*Tons.*	
Packets and miscellaneous boats	3,061	847	1,123	.....	91	113	69	136	925	6,365	211,353
Rafts	.....	.....	2,100	24,046	.....	.....	.....	.....	.....	26,146	2,219,606
Total	3,061	847	3,223	24,046	91	113	69	136	925	32,511	2,430,959

The following comparative table gives the totals for the different classes of freight carried during the years 1890–1894, but with the mile-tons omitted, data to obtain which were gathered only in 1894:

TABLE 2.

Articles.	Tons carried.				
	1894.	1893.	1892.	1891.	1890.
Hay, grain, etc	3,061	3,081	1,547	4,035	2,658
Lumber, logs, wood, railroad ties, etc	27,269	17,915	10,626	19,646	22,806
Live stock	847	144	416	425	209
Produce	136	135	80	67	5
Salt	69	80	23	29	28
General merchandise, farm machinery, etc	1,016	703	237	256	377
Sand and gravel	113	.....	.....	.....	.....
Total	32,511	22,058	12,929	24,458	26,083

From Table 2 the business done in 1894 shows an increase over all the preceding years noted. This increase is a satisfactory one, as it does not appear to be entirely due to the item of railroad ties, which business is liable to vary largely in different years. The largest amount of steamboat trade was carried on by the Hermann Ferry and Packet Company, which had three steamers plying on the river in 1894.

The following table gives the dimensions, with other data of Government inspection, of steam vessels employed in the river trade, as obtained from their enrollment papers in the custom-house in St. Louis, Mo.:

TABLE 3.—*List of steamers plying on the Gasconade River, in the district of New Orleans, enrolled at the port of St. Louis, Mo., during the year 1894.*

Name.	Where built.	Year.	Date of last inspection.	Dimensions.			Total tonnage.	Staterooms.	Berths.	Passengers.		
				Length.	Breadth.	Depth.				Permitted to carry.	First cabin.	Steerage or deck.
				Feet.	*Feet.*	*Feet.*						
Annie Dell*	Hermann, Mo	1889	May 8, 1894	70	16.6	2	19.05	...	...	25	...	25
Gasconade†	do	1891	July 7, 1894	107.4	23.9	3.5	74.35	3	6	35	5	30
Mill Boy†	do	1893	Feb. 9, 1894	89.2	18.8	2.8	41.10	...	...	20	...	20
Peerless†	do	1894	Mar. 8 1894	96.6	21.4	3.5	50.41	2	4	22	...	22
Pin Oak†	do	1888	May 8, 1894	95	17.5	2.2	43.05	...	...	20	...	20
Royal†	do	1884	do	86.6	24	3	44.82	...	...	20	...	20

Name.	Engines.			Boilers.							Name and address of sole or managing owner.
							Flues.		When built.	Steam pressure allowed.	
	Number.	Diameter.	Stroke.	Number.	Length.	Diameter.	Number.	Diameter.			
		In.	*Ft.*		*Ft.*	*In.*		*Inches.*		*Lbs.*	
Annie Dell*	2	6	2	1	10	36	‡14	3 and $3\frac{1}{2}$	1889	130	William L. Heckmann, Mount Sterling, Mo.
Gasconade†	2	9	$3\frac{1}{2}$	1	20	42	5	6 and 10	1891	160	Hermann Ferry and Packet Co., Hermann, Mo.
Mill Boy†	2	8	1	1	14	44	1 and 26‡	24 and 3	1893	110	Do.
Peerless†	2	8	3	1	16	42	2 and 36‡	15 and 3	1894	160	Do.
Pin Oak†	2	8	$2\frac{1}{2}$	1	17	40	‡36	3	1888	125	E. W. Wild, Hermann, Mo.
Royal†	2	8	$2\frac{1}{12}$	1	12	36	5	7	1884	125	H. F. Jones, Neosho, Mo.

* Licensed to run on Osage River.
† Licensed to run on Mississippi and tributary rivers.
‡ Tubes.

Besides these steam vessels the gasoline boat *Hermann* was engaged in the river trade during the year.

Very respectfully, your obedient servant,

J. C. SANFORD,
First Lieut. of Engineers, Secretary.

Lieut. Col. CHAS. R. SUTER,
Corps of Engineers, U. S. A.,
President Missouri River Commission

APPENDIX D.

ANNUAL REPORT OF MR. C. M. WINCHELL, ASSISTANT ENGINEER, 1895.

OFFICE MISSOURI RIVER COMMISSION,
St. Louis, Mo., June 30, 1895.

SIR: I have the honor to submit the following report on the field work of the topographical party under my direction during the season of 1894:

In obedience to instructions from you the party assembled at Jefferson City October 20, 1894, but the quarter boat which we were to have was not ready for occupancy until October 23, on which date a mess was started on the boat and the party towed by the steamer *Melusina* to Stanley Island, 11 miles above Jefferson City.

The party was organized as follows: C. M. Winchell, chief of party; O. H. B. Turner, E. J. Thomas, W. C. Simmons, and C. E. Taylor, topographers; J. C. Barr, levelman; J. W. Link, draftsman; 5 recorders, 17 rodmen and boatmen, 1 watchman, and a galley force of 4; making a total of 34 men.

Work was begun October 24 on a line through Big Rock at right angles to the valley, and progressed downstream until December 19, when the season's survey closed on a north and south line through △ Fey, 1 mile below the mouth of the Gasconade River. A complete topographic survey of the valley was made from Big Rock to △ Fey, extending from the top of the hills on the north to the top of the hills on the south side of the river. All natural features within this area, such as rivers, creeks, sloughs, chutes, islands, bars, etc., were located, also limits of wooded and cultivated areas, and all houses, fences and roads. Vertical angles were read to almost every point located in order to get sufficient data to draw 5-foot contours on the maps.

All elevations are referred to the St. Louis city directrix, and depend for their values on bench marks from a line of precise levels established by the Missouri River Commission in 1892. A line of ordinary Y levels was run along each bank of the river in order to give the topographers frequent opportunities to check their transit elevations. These ordinary levels were also carried back to the hills every few miles to connect with the P. B. Ms.

The survey was based on a system of secondary triangulation done by the Commission in 1885, but these secondary stations were so far apart (5 to 10 miles) and so far back from the river that they did not furnish frequent enough checks on the stadia work. A tertiary system of triangulation was therefore started at Big Rock and carried to △ Fey. This tertiary system was checked by measuring with a steel tape six of the triangle sides, one every 9 miles, and by trigonometrical connection with ten secondary stations.

The party was disbanded at Gasconade December 19, having been out two months. During the winter and spring the notes of the survey have been platted on three detail maps. These maps were completed in pencil about May 20.

I desire to thank my assistants for their willing and hearty cooperation in aid of accurate and rapid work. We are also indebted to Division Engineer Samuel H. Yonge, who kindly sent a steamboat to move our quarter boat from camp to camp as long as we were on his reach.

The following is a résumé of field work accomplished:

RÉSUMÉ.

Secondary △s occupied	14	Number of vertical angles read	31,354
Tertiary △s occupied	109	Number of section corners located	17
Tertiary △s of former surveys located	43	Number of other points permanently marked located	90
Tertiary base lines measured	6	Number of square miles topography	114
Miles of river triangulated	54	Number of miles levels run	105.5
Triangles computed	125	Number of old B. Ms. connected with	40
Miles of stadia line run	484	Number of water surfaces taken	57
Miles of main bank line located	101	Number of county lines located	4
Miles of shore line, including islands and bars	217	Number of miles of river surveyed	54
Miles of bluff line located	99		
Number of points located	33,176		

Very respectfully, your obedient servant,

C. M. WINCHELL, *Assistant Engineer.*

APPENDIX E.

ANNUAL REPORT OF MR. A. H. BLAISDELL, ASSISTANT ENGINEER.

OFFICE MISSOURI RIVER COMMISSION,
St. Louis, Mo., June 30, 1895.

SIR: I have the honor to submit the following report on the water gauges maintained by the Missouri River Commission during the fiscal year ending June 30, 1895:

No new gauges have been established on the Missouri River, but continuous readings have been kept up from the twenty-three permanent and two temporary gauges in use at the end of the last fiscal year, the locations and character of which were published in the report of the Commission for 1894.

From inability to spare the services of an assistant engineer from more pressing work, only one tour of gauge inspection has been made during the year, and that in November, 1894.

With the exception of the gauges at DeWitt, Mo., and Brownville, Nebr., they have all been maintained in fair condition by the observers.

At DeWitt the revetment of the bank by the Wabash Railroad Company in January, 1895, necessitated the partial destruction of the inclined wooden gauge, and temporary gauges were resorted to for low-water readings. Material has been purchased and delivered for a new gauge at this point and it will soon be erected.

At Brownville radical changes in the channel have occurred; during the low-water season the water left the permanent gauges, obliging the use of temporary gauges on bars. At present the tendency appears to be that the water will soon return to the old gauge channel.

The pilot bulletin service maintained at twelve gauge stations between the mouth and Kansas City, Mo., was discontinued on November 30, 1894, except at Kansas City, where the local steamboat men requested that it be made continuous. Ice prevented all river traffic at Kansas City for forty-two days after January 11, 1895, and for this interim the service was discontinued. At the other eleven stations the service was resumed on April 1, 1895.

The bulletins read from the same stage as adopted last year, viz, 5 feet below mean low water at each station, as determined during the fall season when the stage is uninfluenced by ice.

Commencing at the beginning of the calendar year there has been sent early in each week to the division engineers and to the captain of the snag boat a condensed gauge report of the preceding week. This paper gives the stage of water at the close of the week, whether a rising or falling one, the change during the week, the elevation of the highest water of the week, and in the column of remarks any special phenomena which may have occurred.

The manuscript of a third pamphlet in the series of Missouri River stages embracing the four years 1890 to 1893, inclusive, was ready for the printer at the end of the last fiscal year, but from lack of immediate funds the publication was not made. When funds became available it was thought best to include the year 1894 in the publication, and the manuscript of the stages for the additional year is now ready.

Final hydrographs for the five years 1890 to 1895, inclusive, have been completed.

On the Osage River since January 15, 1895, there have been maintained by the Commission four gauges, located at Osage City, Brennekes Shoal, Burds Shoal, and Tuscumbia.

These are the same gauges which had been established in 1891 or previously by Maj. A. M. Miller, Corps of Engineers, U. S. A., then in charge of the river.

A change, however, was made in the method of reporting their records, the same regulations being adopted as on the Missouri River, where each observer reports weekly on a special card bidaily readings of his gauge, and also sends in separate weekly reports of all boats passing and any special river phenomena which may occur in his vicinity.

Very respectfully, your obedient servant,

A. H. BLAISDELL,
Assistant Engineer.

APPENDIX F.

ANNUAL REPORT OF MR. J. C. MEREDITH, DIVISION ENGINEER.

MISSOURI RIVER COMMISSION,
OFFICE OF DIVISION ENGINEER.
Council Bluffs, Iowa, June 30, 1895.

SIR: I have the honor to submit my report of operations conducted on the Missouri River at Omaha, Nebr., for the fiscal year ending June 30, 1895.

The history of the Omaha revetment work is of interest in connection with this report only as it relates to the efforts to lay down limiting lines of control for the left bank of the river from the bluff contact at the location of the North Western dikes to the point below the Council Bluffs Waterworks Pumping Station.

The broken continuity of the revetment work begun in 1889 at the North Western dikes and completed in 1892 to the point below the Interstate Bridge had allowed the development of a pocket in the left-bank shore line about 1 mile above the Interstate Bridge. A break in the revetment at this pocket occurring in 1892 made a deeper recession possible, and this condition, taken in conjunction with the bifurcation of the channel a short distance below the point of impact at the North Western dikes, allowed a varying condition of flow that forced the channel at different times

under the several spans of the Interstate Bridge, and at a varying angle with the line thereof.

I was directed by the president of the Missouri River Commission in his letter to me of September 27, 1894, to make a shore-line survey of the river at Omaha, extending from the mouth of Pigeon Creek to the Interstate Bridge, and after collecting such hydrographic data as would afford an intelligent conception of the conditions in the immediate vicinity of the bridge, to submit a project, with estimates, for the expenditure of the amount appropriated by act of Congress of August 17, 1894.

The survey indicated that the most immediately desired object regarding the change of the river at Omaha was the formulation of some plan to produce a uniform flow in the immediate vicinity of the Interstate Bridge.

The development of a pocket in the left-bank shore line was not of itself a necessary cause in producing the changing conditions, except as taken in connection with the double channel above. When a large percentage of the discharge of the river would follow the left-bank shore line a crossing would occur from the point to the right bank above the bridge; and again, when this discharge would become of lesser importance during the high water the main channel would follow the right bank, making the crossing to the left bank a short distance above the bridge.

A careful examination of the revetment showed the necessity for repairs at various places where the upper-bank paving had been displaced or a partial destruction of the grade had occurred through a sloughing of the bank.

The approved project provided for the expenditure of about 2,000 cubic yards of riprap stone on repairs to the upper-bank paving over the full extent of the Council Bluffs revetment and the placing of a permeable dike system for masking the pocket that had developed in the left-bank shore line.

The material that was needed for repairs to revetment required an expenditure at a low stage of river, and, as any delay in procuring the same not only increased the cost, but threatened the integrity of the work, strand, rock, and brush were purchased in open market under competition of ten days and arrangements made for beginning repair work early in the month of February. Inclement weather preventing the receipts of material delayed the completion of repairs to upper-bank work until the 1st of April.

In the meantime detail plans and specifications for dike construction, with specifications and bills for the material thereof, had been prepared.

All of the piling, lumber, strand, cable, and fastenings for construction, as well as special tools required in the prosecution of the work, were advertised and contracts duly executed for completion of delivery by June 30, 1895. The rock, brush, and poles, being required for such delivery as might be in accordance with the exigencies of construction work, were purchased in open market under competition of ten days.

A sufficiently commodious room in the post-office building at Council Bluffs was assigned for occupancy as an office for the transaction of business pertaining to the local work as well as the general business of the Omaha division and an office force commensurate with the immediate demands of the work installed therein.

The total lack on the Omaha division of any plant for the successful prosecution of dike work necessitated the hire of such plant as could be procured in the vicinity of Omaha or at other points on the river within the limits of reasonable transportation.

Under authority from the Chief of Engineers, dated April 19, 1895, arrangements were made for the use of plant as follows, viz:

Steamer *Mary E. Bennett,* with crew, for transporting plant and material; two floating pile sinkers, outfitted complete for use as combination friction-hammer and hydraulic-jet sinkers; one land driver, outfitted complete for use as combination friction-hammer and hydraulic-jet sinker; eleven barges, to be used as working plant for dike construction and for transportation of such material as could not be economically delivered by rail.

A spur track was laid by the Omaha Bridge and Terminal Railway Company from their main line to a barging point near the abandoned United States boat yard for the delivery of such material as by stipulation should come over their line for acceptance on track at nearest accessible point of expenditure.

After the completion of all these arrangements for an early inauguration of construction operations and an energetic prosecution of dike work prior to the June rise it became necessary to await the receipt of materials that by terms of delivery were long past due.

PILE DRIVING.

The three pile drivers used on construction were put to work May 3, May 17, and June 1, respectively, after undergoing certain alterations to adapt them to the kind of work required.

The arrangement was much the same in each and consisted in a regular land pile driver placed on a barge and outfitted with a heavy hammer, leads, and friction drum hoist, supplemented with a boiler and pump capable of maintaining a 1-inch diameter hydraulic jet with a nozzle pressure of 100 pounds.

A pile cap, or follower, was furnished with each apparatus to hold the head of the pile in place. The hoisting tackle attached to the pile that was being driven was sufficiently strong for lifting not only the pile when partially sunk, but the superincumbent weight of pile cap and hammer as well, thus placing the manipulation of sinking at all times under perfect control.

The requirements of pile driving called for an average penetration of 25 feet, with a minimum allowable of 20 feet.

The piles in each dike, except where introduced as a reenforcement at extra exposed points, are placed in triangular plan, measuring in place 10 feet center to adjacent piling.

Clusters are driven at the outer dike corners and other specially exposed points.

The peculiar locations of the different dikes made it expedient that the pile work should precede mattress construction, and that frequent changes should be made from dike to dike to induce or subvert certain anticipated effects arising from local or temporary conditions, the order of construction being carried on in such sequence as to expose to a minimum degree work previously placed and plant hired by the Commission.

MATTRESS WORK.

Temporary sloping mattress floors without the customary ways were constructed in sections to make proper combinations for the different widths of mattress required.

The construction of mattresses was commenced May 19 and has proceeded on the various dikes as the exigencies of the work demanded. The widths of mattress sill on the different dikes varies as follows:

For two-row cross dike, 25 feet; for independent three-row cross dike, 40 feet, except at the outer end, where the width was increased to 75 feet.

The mattress sill for the training dike and for the header dike was 125 feet, with the use of a special longitudinal reenforcement at the upper and outer selvage.

The mattress for trailing or buttress dike is 90 feet wide and extends 50 feet below the end of the pile work.

Three-eighths-inch strand, doubled, is used every 10 feet, blocking the mattress out in 10-foot squares.

BRACING.

The piles are capped with 6 by 8 inch long-leaf yellow-pine timbers driftbolted thereto, while all wales and direct and drop braces are fastened with seven-eighths-inch diameter screw bolts.

The screening or curtaining is done either with poles thrust through the foot mat and spiked to wales at the upper end or with a woven brush mattress.

The system of permeable dikes, the location and extent of each as proposed, and the state of completion of the project are indicated on the accompanying map.

There are six cross dikes in all, aggregating 3,800 feet, with a training dike at the head of the system 2,600 feet in length.

The necessity for carrying on construction operations with plant not well adapted to the purpose or method, with an insufficient supply of construction material for the energetic prosecution of the work, and with crews largely unfamiliar with the kind of work, has rendered progress slow.

The necessity for furnishing means for transportation of brush from the various landings to the point of expenditure has rendered the available towing facilities inadequate for use in moving the various materials from the railway terminus to location of dikes; a considerable portion of rock, piling, and lumber has been moved by team from the material yard to the different dikes, involving extra initial cost in delivery.

The incomplete condition of all the dikes renders possible but a statement of disbursements and a partial bill of cost, submitted in appended Exhibit A.

Very respectfully, your obedient servant,

J. C. MEREDITH, *Division Engineer.*

EXHIBIT A.

Statement showing expenditure on dike construction in vicinity of Omaha, Nebr., 1895.

Classification.	Labor.	Material.	Total.
Weaving mattress (1,894 linear feet; 126,433 square feet):			
Labor	$1,454.43		
Material—			
830.43 cords brush, at $1.65 per cord		$1,370.21	
36.08 cords brush, at $2.25 per cord		81.18	
41.70 cords brush, at $1.50 per cord		62.55	
Total	1,454.43	1,513.94	$2,968.37
Ballasting mattress (1,641 linear feet; 96,680 square feet):			
Labor	645.75		
Material—			
706.79 cubic yards rock, at $1.22½ per cubic yard		865.82	
202 cubic yards rock, at $1.77 per cubic yard		357.54	
Total	645.75	1,223.36	1,869.11
Anchoring mattress (750 linear feet):			
Labor	106.84		
Material—			
1,608 pounds ⅜-inch strand, at $2.28 per cwt		36.66	
15,606 pounds ⅜-inch strand, at $2.59 per cwt		404.20	
750 feet 1⅛-inch cable, at $1.25 per foot		9.37	
Total	106.84	450.23	557.07
Driving piling (648 piles):			
Labor	2,040.41		
Loading piling	258.50		
Hauling piling	256.88		
Barging piling	137.94		
Material—			
100 35-foot piles, 3,500 linear feet, at 15 cents per linear foot		525.00	
152 40-foot piles, 6,080 linear feet, at 15¼ cents per linear foot		927.20	
262 45-foot piles, 11,790 linear feet, at 16 cents per linear foot		1,886.40	
98 50-foot piles, 4,900 linear feet, at 17 cents per linear foot		833.00	
36 55-foot piles, 1,980 linear feet, at 17½ cents per linear foot		346.50	
2,000 bushels coal, at 11⅕ cents per bushel		224.00	
Total	2,693.73	4,742.10	7,435.83
Structural work (763 pieces):			
Labor	1,342.03		
Material—			
378 pieces 6 by 8 inches by 22 feet, 33,264 feet, B. M., at $16.50 per M		548.86	
197 pieces 6 by 8 inches by 12 feet, 9,456 feet, B. M., at $15.50 per M		146.57	
18 pieces 4 by 8 inches by 24 feet, 1,152 feet, B. M., at $16.50 per M		19.01	
53 pieces 4 by 8 inches by 22 feet, 3,109 feet, B. M., at $16.50 per M		51.30	
68 pieces 4 by 8 inches by 16 feet, 2,901 feet, B. M., at $15.50 per M		44.96	
49 pieces 4 by 8 inches by 12 feet, 1,568 feet, B. M., at $15.50 per M		24.30	
1,816 pounds ¾ by 20 inch driftbolts, at $1.65 per cwt		29.96	
919 pounds 1 by 30 inch driftbolts, at $1.65 per cwt		15.16	
2,173 pounds ⅞ by 22 inch washers, at $1.61 per cwt		34.98	
1,404 pounds ⅞ by 26 inch washers, at $1.61 per cwt		22.60	
200 pounds 5/16 by 2½ inch hole washers, flat, at $2.20 per cwt		4.40	
350 pounds ⅞ inch cast washers, at $1.55 per cwt		5.43	
400 pounds ½ by ½ by 10 inch boat spikes, at $2.25 per cwt		9.00	
100 pounds ⅜ by ⅜ by 8 inch boat spikes, at $2.35 per cwt		2.35	
500 pounds 60d wire spikes, at $1.35 per cwt		6.75	
Total	1,342.03	965.63	2,307.66
Curtaining dikes (640 linear feet):			
Labor	16 56		
Material—			
25.2 cords poles, at $1.90 per cord		47.88	
4.8 cords poles, at $2.50 per cord		12.00	
Total	16.56	59.88	76.44

EXHIBIT A—Continued.

Statement showing expenditure on dike construction, etc.—Continued.

Classification.	Labor.	Material.	Total.
Constructing abutments (five):			
Labor	$42.69		
Material—			
115 cubic yards rock, at $1.77 per cubic yard	.....	$203.55	
23 cords brush, at $1.65 per cord	.....	37.95	
12 cords brush, at $1.50 per cord	.....	18.00	
Total	42.69	259.50	$302.19
Hauling construction material	205.37	.....	205.37
Unloading construction material	403.07	.....	403.07
Total amount expended on dike construction	.....	.....	15,722.04

Statement of miscellaneous expenses in vicinity of Omaha, Nebr., 1895.

Classification.	Labor.	Material.	Total.
Survey	$366.47	.....	$366.47
Care of plant	350.20	92.72	442.92
Alterations and repairs to plant	463.17	129.70	592.87
Construction of warehouse, portable mattress ways, and stone chutes:			
Labor	113.25		
Material—			
Lumber	.....	300.66	
Hardware	.....	17.91	
Roofing felt	.....	20.00	
Total	113.25	338.57	451.82
Construction of skiffs (six):			
Labor	118.56		
Material—			
Hardware	.....	1.55	
Lumber	.....	96.40	
Total	118.56	97.95	216.51
Construction of three engine houses:			
Labor	23.38		
Material—			
5,500 feet, B. M., lumber	.....	84.16	
Hardware	.....	4.13	
Roofing felt	.....	4.00	
Total	23.38	92.29	115.67
Towage:			
Labor	176.00		
Subsistence	.....	11.86	
Coal	.....	215.96	
Total	176.00	227.82	403.82
Plant purchased: Tools, ropes, lines, oars, wrenches, anchors, hose, etc.	.....	465.08	465.08
Hire of plant:			
1 steamer 35 days, at $30 per day	.....	.....	1,050.00
1 steamer 16 days, at $25 per day	.....	.....	400.00
1 pile sinker 35 days, at $8 per day	.....	.....	280.00
1 pile sinker 9½ days, at $6 per day	.....	.....	57.00
1 floating pile sinker 54 days, at $13.50 per day	.....	.....	729.00
1 floating pile sinker 30 days, at $16 per day	.....	.....	480.00
3 barges 1 day, at $2.50 per day each	.....	.....	7.50
4 barges 34 days, at $2.50 per day each	.....	.....	340.00
5 barges 25 days, at $1.50 per day each	.....	.....	187.50
7 barges 10 days, at $1.50 per day each	.....	.....	105.00
11 barges 27 days, at $1.50 per day each	.....	.....	445.50
Switching charges	.....	.....	195.00
Total amount of miscellaneous expenses	.....	.....	7,734.73

Cost of administration and superintendence.

Classification.	Cost of each item.
Labor	$2,135.26
Telegrams	1.28
Telephone	23.90
Expressage	2.90
Traveling expenses	75.61
Total	2,238.95

Statement of cost of repairing bank work in the vicinity of Omaha, Nebr., 1895.

Classification.	Labor.	Material.	Total.
Ballasting bank (10,250 linear feet)	$346.44	*$2,710.10	$3,056.54

*1,531.13 cubic yards rock, at $1.77 per cubic yard.

RECAPITULATION.

Total expenditure on dike construction	$15,722.04
Total amount of miscellaneous expenses	7,734.73
Total cost of administration and superintendence	2,238.95
Total cost of repairing upper bank work	3,056.54
Grand total	28,752.26

APPENDIX G.

ANNUAL REPORT OF MR. J. C. MEREDITH, DIVISION ENGINEER.

MISSOURI RIVER COMMISSION,
OFFICE OF DIVISION ENGINEER,
Council Bluffs, Iowa, June 30, 1895.

SIR: I have the honor to submit my report of operations conducted on the Missouri River in the vicinity of St. Joseph, Mo., during the fiscal year ending June 30, 1895, as follows, viz:

The history of the work now in place in the vicinity of St. Joseph extends back to the placing of the Elwood revetment in 1883, and includes during the various years the revetment work in Bon Ton and Belmont bends for bank protection, and the dikes at Greyback Island for channel rectification.

An investigation of the existent work in the vicinity of St. Joseph indicated the futility of attempting the reestablishing of the dike work, and the necessity of more or less repair work over, approximately, the full extent of revetment in Bon Ton and Belmont bends, respectively. There were found to be twelve breaks, aggregating 1,430 feet of bank, exposed by a total or partial destruction of the grade in Bon Ton Bend to further erosion and development into destructive eddies.

Four minor breaks in Belmont Bend, aggregating 325 feet, involved no further damage than a partial destruction of the grade.

The approved project for the expenditure of $22,000 contemplated such general repairs as would place all revetment work, as near as might be, in its original state of integrity.

These repairs consisted in replacing rock where the bank had been denuded of paving, fairing out the slope where the grade had been partially or wholly destroyed, supplementing with pocket or floor mattress where the destruction of grade had extended beyond the anchorages, and a general reinforcement of the upper bank paving near the low-water lines. It had been expected to do all the necessary mattress work upon the ice and to make all bank repairs in the way of reinforcing ballast before the general break-up of the ice in the spring.

Construction material for the proper repairing of revetment for both Bon Ton and Belmont bends was purchased in open market on ten-day proposals. The delivery of riprap stone was to begin February 1, and to be completed by March 1. Various causes operated in delaying the first delivery until February 28, and the final delivery until April 20.

As soon as it was evident that sufficient material was on hand to warrant the inauguration of active repair operations, an office for the conduct of local business was

opened in St. Joseph, Mo., March 1, with W. H. Floyd, jr., as assistant engineer in local charge, and active repair work begun March 16, and carried on continuously until April 6, at which time a sudden rise in the stage of the river of 3½ feet interrupted the progress of the work entirely for one week. Operations were resumed the 13th of April and prosecuted to completion.

The delay in the receipts of construction material necessitated the preparation of plans for making mattress from floating plant, and authority was therefore procured for the hire of steam tender *Bee* at $15 per day and one barge for use as a mattress boat at $4 per day. Temporary mattress ways were erected on the barge and mattress construction was begun April 24.

There were three pockets that had developed to such an extent as to necessitate mattress work, requiring a total of 50,052 square feet of willow mattress. The construction of this was completed May 11, and the laboring force disbanded.

An inspection of the work shortly thereafter indicated the necessity of further work at the lower end of the revetment in Belmont Bend. A considerable sloughing had taken place, such as threatened the integrity of the work, and operations were, therefore, resumed toward repairing this particular break, and continued to completion on May 22, at which time, as all the work that had been projected at St. Joseph had been completed, the force was disbanded and the office closed.

Of the construction material that was ordered for repair work, there was left in Bon Ton Bend 540 cubic yards of rock, distributed at various points between the St. Joseph Waterworks Pumping Station and the lower end of the Bon Ton revetment.

There was left in Belmont Bend 565 cubic yards of rock, distributed from the head of the revetment to a point 12,800 feet below.

The Bon Ton revetment is in as good condition as would be possible without undertaking a radical system of repair, involving the masking of the numerous pockets that have developed in the shore line.

The Belmont work is in excellent condition from the head of the 1891 revetment to the lower end of the work done in 1893.

A crossing occurs from the point at the lower end of the Belmont revetment, so that no portion of the Elwood revetment is exposed to attack from the river.

I have the honor to submit herewith a bill of cost of repair work done at St. Joseph, Mo.

Statement showing cost of repairs at St. Joseph, Mo.

COST OF ADMINISTRATION AND SUPERINTENDENCE.

Classification.	Cost of each item.
Labor	$1,254.58
Traveling expenses	74.25
Office rent	41.00
Total	1,369.83

COST OF REPAIR WORK.

Nature of work.	Hire of plant.	Labor.	Material.	Total.
Repairs to upper bank, Belmont Bend (12,980 linear feet)	.....	$1,095.16	$3,331.95	$4,427.11
Repairs to upper bank, Bon Ton Bend (5,809 linear feet)	.....	786.41	2,217.38	3,003.79
Mattress construction in Bon Ton Bend (706 linear feet, 50,062 square feet)	.....	507.13	813.52	1,320.65
Construction of temporary mattress ways	.....	24.38	36.18	60.56
Towage	$100.00	34.00	27.28	161.28
Care of plant	.....	28.13	29.04	57.17
Total	100.00	2,475.21	6,455.35	9,030.56

RECAPITULATION.

Cost of administration and superintendence	$1,369.83	
Cost of construction work	9,030.56	
		$10,400.39
Material purchased but unexpended June 30, 1895:		
540 cubic yards rock, at 94 cents per cubic yard	507.60	
565 cubic yards rock, at 97 cents per cubic yard	548.05	
10,000 feet ⅜-inch strand	70.71	
40.6 cords brush, at $1.75 per cord	71.05	
		1,197.41
Total expenditure on St. Joseph reach		11,597.80

Very respectfully, your obedient servant,

J. C. MEREDITH, *Division Engineer.*

APPENDIX H.

ANNUAL REPORT OF MR. J. C. MEREDITH, DIVISION ENGINEER.

MISSOURI RIVER COMMISSION,
OFFICE OF DIVISION ENGINEER,
Council Bluffs, Iowa, June 30, 1895.

SIR: I have the honor to submit my report of operations conducted on the Missouri River at Atchison, Kans., for the fiscal year ending June 30, 1895, as follows:

A special survey was made of the reach of river extending from Geary City to Atchison, under instructions from the president of the Missouri River Commission, in his letter to me, dated September 27, 1894. A map of the survey accompanies this report, and shows the progress of improvement, as well as the destruction of work previously placed, which followed as a sequence to the Doniphan Cut-off of 1891.

The break in the Mud Lake revetment constructed by the railway companies in the winter of 1887 and 1888, its gradual enlargement until the upper limits of the system of dikes constructed by the Commission in 1889 were reached, and then the flanking of the dikes and their subsequent total destruction, one by one, were but events in the history of the erosion that since 1892 has taken in over 200 acres of land, by the obliteration of about 1 mile of the protected bank, extending from the Commission's Dike No. 2 to Point A on the Mud Lake revetment.

The excessive slopes and continued erosion at various points between Geary City and Atchison rendered the entire reach of unstable regimen and the conditions of flow very changeable and erratic. No systematic effort toward the amelioration of the river at Atchison could be undertaken without considering the entire reach comprised in the extent of river surveyed. The immediate danger that was apprehended, and by which more interests were threatened, was the flanking of the Chicago and Atchison Bridge, used by the various railways in crossing the river at Atchison.

The approved project, making available for construction work $20,000, and reserving $15,000 as an emergency fund, contemplated the extension of the revetment, in the vicinity of the east abutment of the Chicago and Atchison Bridge, upstream, to a point less vulnerable, where any further attack by the river could be more successfully combated than in the vicinity of the old Dike No. 2.

The extension of this revetment, undertaken as a temporary expedient, was further justified by the expectation that the development of the bend below Mud Lake, the exhaustion of the destructive slope, and the constant erosion at the head of Atchison Island, would all tend toward a cut-off in the neighborhood of the old Atchison slough.

As the money immediately available, $20,000, was insufficient to carry the revetment beyond and away from the railways, arrangements were made with Mr. N. D. Todd, the receiver of the Chicago and Atchison Bridge Company, whereby a portion of the construction material, brush and stone, for use in revetment would be furnished on cars on the protection track already in place along the portion of bank to be revetted, without cost to the Missouri River Commission. By this arrangement the Commission undertook the construction of 5,000 linear feet of revetment, furnishing all other material, plant, and labor.

The danger of flanking the bridge was so imminent and the emergency so great as to offer sufficient warrant for beginning work as soon as construction material could be collected.

It was further expected that, by the initiation of work whilst the river was frozen over, a large portion of the expenses estimated for floating plant could be used for application on revetment construction, thus allowing the extent of mattress work to be further increased.

The construction of the 5,000 feet of revetment projected left the upper end of the mattress at the foot of the shore bar, and was not otherwise specially protected from further encroachment, with insufficient room for the extension of the mattress header to prevent flanking. It became, therefore, advisable to reduce the cost of work, at considerable risk, so that the revetment might be increased to such an extent as to reach above the abandoned Kansas City, St. Joseph and Council Bluffs Railway right of way.

As soon as sufficient construction material had been delivered to justify the commencement of work, I was ordered to take the field and begin operations at once. Mattress construction was begun with two parties, commencing February 5 and 6, respectively, and prosecuted as energetically as the receipts of material would allow. It was necessary in the progress of this work to make such disposition of the labor as to expose at any time a minimum amount of work, in case there should be a sudden movement of the ice.

The aggregate length of 6,302 feet of mattress was woven in six sections, as follows:

The first piece of mattress, placed to anticipate any eddy action that might set in below the point, extended from the root of rock Dike No. 2 to the head of the bridge abutment revetment, placed in 1888–89, lapping well over the same.

The second piece was commenced 1,600 feet above the point, and was extended in each direction.

The third piece was commenced 3,750 feet above the point, and extended downstream.

The fourth piece was begun 4,850 feet above the point, and was extended in both directions.

The fifth piece was woven on floating mattress pontoons, picking up section 4 and continuing it downstream, and lapping section 3.

The sixth piece of mattress was commenced at the head of the proposed revetment, and, extending downstream, lapped section 5.

Mattress weaving on the ice was continued until February 28, when a general movement of the ice interrupted for a time all mattress construction, and it became necessary to make preparations for continuing work on such floating plant as could be temporarily constructed. Five pontoon boats were therefore built, mattress ways erected thereon, and, with a sixth boat loaned by the Chicago and Atchison Bridge Company, work was resumed March 6 and continued to completion March 19.

The final work of ballasting, however, involving the sinking of the mattress and the expenditure of rock on the upper bank paving, was not completed until April 10.

As the method of mattress construction without the use of floating plant and the ballasting of same involve certain departures from precedent, the following description of method of construction followed is submitted:

The details of mattress construction vary but little from the mattress heretofore approved by the Commission. The width constructed at Atchison was in all cases not less than 100 feet, and at specially vulnerable points was increased to 120 feet. The system of anchorages involved the use of double transverse and longitudinal $\frac{3}{8}$-inch strand, dividing the mattress into 10-foot squares.

The weaving proceeded upstream or downstream, indifferently, according to the various contingencies arising to give special method to the construction. It was found, however, that in ballasting operations the usual method of sinking downstream involved certain elements of danger that could be avoided by an upstream progress. The usual method, therefore, was to carry the advancing line of distribution so that the upper and outer end would be 100 feet ahead, thus insuring a complete ballasting before the ice would shear off, and the outer edge be flooded with water. The thickness of the ice, drifts of sand and snow, and other elements entering into the problem of proper amount of ballasting material to sink the mattress are so variable that a definite expenditure per square could not be specified. The usual method was to continue an expenditure of rock until there would be a slight flooding of the ice, and then the mattress was left until sufficient wear from the action of the water underneath, and the subsequent shearing off at the outer edge, allowed the gradual sinking of the mattress and ice. All the mattress was sunk successfully, without any loss whatever. It was arranged in this way, that although the mattress had been made in six different sections, there were but two laps made, and therefore a minimum loss of mattress from duplication.

The project contemplated but little bank grading, no more, in fact, than would be necessary for the reduction to an approximate rock slope, so that any movement of the inner edge of the mattress might be followed by a sliding down of the rock, an automatic adjustment of the upper bank paving to suit the new conditions.

Excavation for dead men, to which strand and cable were attached for anchorage, was facilitated by the use of dynamite, two half-cartridges proving quite sufficient to successfully break all frost, even where it had extended to the depth of 20 inches; and the cost of placing bank anchorages was but little more than would be usual in the prosecution of the work in summer weather.

The distribution of the rock over the mattress would exceed in cost the usual method of distribution from floating plant, inasmuch as all the ballasting material was necessarily taken from the protection track or the foot of the bank and distributed over the mat in wheelbarrows. It was found, however, that because no delay was occasioned on account of fleeting the floating plant from under the mattress better progress could be made in weaving than is usual, and with the exception of certain difficulties encountered in obtaining the tension of longitudinal strand and cable just as good mattress could be constructed.

After all the mattress had been constructed and ballasted to place, there was extended at the upper end thereof, and at right angles to the line of flow, a mattress header measuring 150 feet in width and extending back 100 feet from the bank. This was placed to prevent any encroachment by means of flanking; and it was expected that the progress of erosion would not reach the inner or land end of the mattress before the June rise, at which time it was expected that a further extension would be necessitated, in order that the mattress header might perform its proper function and resist all flanking tendency.

The erosion in the immediate vicinity of the upper end of the mattress has been almost continuous to a point of impact about 3,500 feet above. No complications have arisen, and the work has proven successful and has done all that was expected of it. It was found at an early period of the June rise that erosion would probably extend so far as to let down the upper corner of the mattress, and arrangements were at once made for the further extension of the mattress header 200 feet inland. The cost of this extension is given in a separate statement.

The excavation of a canal near the old Atchison Island slough, undertaken by the Chicago and Atchison Bridge Company for the purpose of expediting the desired cut-off, will probably delay instead of facilitate the action, inasmuch as the volume carried by this canal will reduce the slope between the upper and lower bend, and, therefore, will lessen the amount of cutting there, while retarding the influence of further development in the bend immediately above the works and the exhaustion of the slope from natural causes, with a consequent increase of the slope from the upper to the lower end of Atchison Island. There may be, however, a sufficient concentration of slope at present to produce an erosion commensurate with the volume of water flowing through the canal, and it may widen and ultimately carry the full discharge of the river.

There is submitted herewith a statement of extent and cost of the work done in the vicinity of Atchison.

A supplemental statement, showing cost of extension to mattress header, will be submitted as Exhibit A.

Statement showing cost of work in vicinity of Atchison, Kans., 1895.

COST OF ADMINISTRATION AND SUPERINTENDENCE.

Classification.	Cost of each item.
Labor	$1,168.67
Traveling expenses	236.80
Office rent	50.00
Supplies	1.80
Telegrams	.98
Expressage	2.15
Total	1,460.40

COST OF REVETTING 6,250 LINEAR FEET OF BANK.

Classification.	Labor.	Material.	Total.
Weaving mattress (6,302 linear feet; 681,310 square feet)	$5,275.69	$111.00	$5,386.69
Ballasting mattress and bank paving	4,324.69	.....	4,324.69
Anchoring mattress	1,508.13	2,551.62	4,059.75
Construction of pontoons and mattress ways (5 pontoons and 100 feet width of ways)	164.75	247.22	411.97
Construction of tool boxes, rock chutes, and gang planks	5.06	29.56	34.62
Care of plant	73.50	.....	73.50
Survey (5 miles of shore line)	46.25	.....	46.25
Purchase of new plant:			
Rope	.....	15.44	.....
Rubber boots	.....	19.20	.....
Shovels, tools, etc	.....	67.38	102.02
Total	11,398.07	3,041.42	14,439.49

Miscellaneous data and elements of cost.

Total number of days labor on revetment	8,327⅓
Average cost of labor per day on revetment	$2.3339
Labor cost of weaving mattress per square—100 square feet	.7743
Labor cost of anchoring mattress per square—100 square feet	.2213
Labor cost of weaving and anchoring per linear foot	1.764
Labor cost of ballasting and paving per linear foot	.6862
Total cost of revetment, including 4,545 cords brush, at $1.4774, and 23,845 cubic yards rock, at $0.7437, furnished by the Chicago and Atchison Bridge Company	38,220.10

Very respectfully, your obedient servant,

J. C. MEREDITH, *Division Engineer.*

EXHIBIT A.

Bill of cost of mattress header extension at Atchison, Kans., 1895.

Classification.	Labor.	Material.	Total.
Weaving mattress (266 linear feet; 43,624 square feet):			
Labor	$331.25	.....	
Material—			
123.92 cords brush, at $1.80 per cord	.....	$223.06	
72.60 cords brush, at $1.50 per cord	.....	108.90	
Total	331.25	331.96	$663.21
Ballasting mattress:			
Labor	349.06	.....	
Material—			
700 pounds No. 12 wire, at $2.25 per cwt	.....	15.75	
1,060 cubic yards rock, at $1.23 per cubic yard	.....	1,303.80	
Total	349.06	1,319.55	1,668.61
Anchoring mattress:			
Labor	46.41	.....	
Material—			
4,695 pounds ⅜ inch strand, at $2.59 per cwt	.....	121.60	
Total	46.41	121.60	168.01
Grand total	.....	.....	2,499.83

Administration and superintendence.

Classification.	Labor.	Expense.	Total.
Labor	$354.43	.....	
Traveling expenses	.....	$27.44	
Office rent	.....	56.67	
Total	354.43	84.11	$438.54

The item of administration includes the period of inactivity extending from April 14, 1895, to June 3, 1895.

APPENDIX I.

ANNUAL REPORT OF MR. J. C. MEREDITH, DIVISION ENGINEER.

MISSOURI RIVER COMMISSION,
OFFICE OF DIVISION ENGINEER,
Council Bluffs, Iowa, June 30, 1895.

SIR: I have the honor to submit herewith my report of operations conducted on the Missouri River at Leavenworth, Kans., during the fiscal year ending June 30, 1895.

The estimates for work at Leavenworth, Kans., presupposed a location in the vicinity of the new railway bridge to prevent the flanking thereof, as such a tendency had been existent for some time, due to the bifurcation of the channel immediately after passing through the high bridge at Fort Leavenworth.

A survey of the reach between the two bridges and the collection of hydrographic data to determine the proper solution of the problem were undertaken shortly after receipt of your letter of November 8, directing a shore-line survey and examination.

The original project provided for the construction of three dikes, all above the slack dump of the Home Coal Mine. As the estimate for these three dikes was more than could be allotted for the improvement at Leavenworth, the project was modified to include two permeable dikes, so that the lower dike would remain as located and the upper dike halfway between the first and second dikes originally projected. The estimated cost of these two dikes came within the limit of amount allotted for Leavenworth, Kans., and I was directed to prepare bills of construction material for carrying out the approved project.

It was expected to begin dike construction early in the month of April, and to complete the project by June 30. All arrangements for delivery of material, organization of construction party, and hire of plant had been made in accordance with this plan.

A portion of the construction material, consisting of piling, lumber, strand, cable, and miscellaneous hardware, and special tools for carrying on dike operations, was purchased under contract, deliveries to begin April 1 and to be concluded by June 30, 1895. All other material, rock, brush, and poles, was purchased in open market, under competition of ten days.

An office was opened in the Manufacturers' National Bank Building April 10, and a part of the Atchison administrative force transferred thereto, their first operations consisting in making a shore-line survey, and relocating the thirteen ranges sounded the previous season, and in the construction of a working map to a scale of 250 feet to the inch.

Arrangements had been made for the utilization of a part of a sand-dredging plant, to be hired at St. Joseph, Mo., consisting of steamer *Bee*, two decked barges, and two open scows, at a charter price of $25 per day; a pile-driving outfit was to be supplied by an Omaha contractor, at a charter price of $16 per day; three barges were to be furnished by the Missouri River Bridge and Iron Works, at a charter price of $1.50 per day each; a steam pile driver, outfitted with a Vulcan-Nasmyth hammer, arranged for working from the top of dike, from barge, or on land, was purchased for delivery at Leavenworth early in June, 1895.

The pile-driving outfit was received from Omaha on the 3d of May, and work was at once commenced toward putting it in condition for utilization on the work. In the meantime the shore bar at both Dike No. 1 and Dike No. 2 was of such height that it was not expected a floating mattress plant could be run over it at any date in the near future; therefore pontoons were arranged for making mattress across the inner chute and the shore bar.

Weaving was commenced on Dike No. 1, May 8, and was continued until the mattress had progressed to the deep water. Construction was then commenced on Dike No. 2, and was carried out to the outer line of the shore bar.

Pile driving with the plant hired from Omaha was commenced on May 21, and has been continued at about one-half capacity during the months of May and June. A delay had been occasioned in the inauguration of pile driving and structural work by the nonarrival of the construction material ordered of C. L. Chaffee.

The first car of lumber was not received until the 17th of May; the first car of piling was received the 18th of May; the contract stipulated that deliveries should commence nearly six weeks prior to this.

It had been expected that the specified delivery of the construction material would allow the completion of the Leavenworth dike system by June 30, 1895, and the utilization of the Vulcan steam driver for the completion of work at Omaha.

The fact that two essential kinds of construction material, viz, piling and lumber, have been furnished in insufficient quantities to keep the one pile-driving apparatus in continuous use has allowed an unusual delay in the delivery of the Vulcan-Nasmyth hammer. The latter was received at Leavenworth June 22, 1895.

The Leavenworth dike-construction work has been carried on as energetically as the receipt of construction material would allow.

The progress of the work at Leavenworth has been without incident, excepting a slight interference with pile driving, caused by the accumulation of drift during a rise, and the scouring out of a few piles that had been driven ahead of the mattress work.

The method of construction is in all respects similar to that carried on at Omaha, the structural work varying, however, in the one detail of omitting all drop braces. The screen, width of mattress sill, and details of mattress construction are the same in every particular.

A map of the Leavenworth reach transmitted herewith shows the location of the dikes and of construction operations thereon.

Recent soundings show a partial closure of the left-bank chute and a considerable bar growth opposite the city of Leavenworth, indicating the probable favorable action of the two dikes as located. It may be expected, however, that there will be a low-water channel crossing under the lower dike, and requiring probably a short piece of dike for the closure of the chute generated thereby.

The progress of construction at the present date is in such a state of incompletion that nothing more than a statement of disbursements and a partial bill of costs can be submitted as appendix Exhibit A.

Very respectfully, your obedient servant,

J. C. MEREDITH. *Division Engineer.*

EXHIBIT A.

Statement showing expenditure on dike construction in vicinity of Leavenworth, Kans., 1895.

Classification.	Labor.	Material.	Total.
Weaving mattress (1,471 linear feet; 48,930 square feet):			
Labor, weaving mat, carrying and handling brush	$917.90	.....	
Material—			
72.61 cords brush, at $1.15 per cord	.....	$83.50	
393.39 cords brush, at $1.65 per cord	.....	649.09	
Total	917.90	732.59	$1,650.49
Ballasting mattress:			
Labor, ballasting mat and loading rock	414.93	.....	
Material, 796 cubic yards rock, at 79 cents per cubic yard	.....	628.84	
Total	414.93	628.84	1,043.77
Anchoring mattress:			
Labor, anchoring mattress and handling material	146.16	.....	
Material—			
9,340 pounds $\frac{3}{8}$-inch strand at $2.59 per cwt	.....	241.90	
150 feet cable, $1\frac{1}{8}$-inch, second-hand, at $1\frac{1}{4}$ cents per foot	.....	1.88	
Total	146.16	243.78	389.94
Pile driving (341 pieces):			
Labor, driving, loading, barging, unloading, and hewing	1,341.42	.....	
Material—			
27 pieces 30-foot piling, 810 linear feet, at 14 cents per linear foot	.....	113.40	
64 pieces 35-foot piling, 2,240 linear feet, at 15 cents per linear foot	.....	336.00	
194 pieces 40-foot piling, 7,760 linear feet, at $15\frac{1}{4}$ cents per linear foot	.....	1,183.40	
42 pieces 45-foot piling, 1,890 linear feet, at 16 cents per linear foot	.....	302.40	
14 pieces 50-foot piling, 700 linear feet, at 17 cents per linear foot	.....	119.00	
Total	1,341.42	2,054.20	3,395.62
Structural work (245):			
Labor	320.37	.....	
Material—			
1 piece 4 by 8 inches by 22 feet, 59 feet, B. M., at $16.50 per M	.....	.97	
27 pieces 4 by 8 inches by 24 feet, 1,728 feet, B. M., at $16.50 per M	.....	28.51	
216 pieces 6 by 8 inches by 22 feet, 19,008 feet, B. M., at $16.50 per M	.....	313.63	
11 pieces 6 by 8 inches by 12 feet, 528 feet, B. M., at $15.50 per M	.....	8.18	
850 pounds $\frac{7}{8}$ by 26 inch screw bolts, at $1.64 per cwt	.....	13.94	
978 pounds $\frac{7}{8}$ by 22 inch screw bolts, at $1.64 per cwt	.....	16.04	
418 pounds 1 by 1 by 30 inch driftbolts, at $1.54 per cwt	.....	6.44	
1,156 pounds $\frac{3}{4}$ by 20 inch driftbolts, at $1.54 per cwt	.....	17.80	
100 pounds ogee washers, at $1.75 per cwt	.....	1.75	
125 pounds washers, $\frac{5}{16}$-inch hole by $2\frac{1}{4}$ inches, at $2.10 per cwt	.....	2.63	
20 pounds, 6 by 3 inch staples, at $2.40 per cwt	.....	.48	
Total	320.37	410.37	730.74
Total amount expended on dike construction	.....	.....	7,210.56

Statement of miscellaneous expenses in vicinity of Leavenworth, Kans., 1895.

Classification.	Labor.	Material.	Total.
Care of plant:			
Labor	$214.67	.....	
Supplies—			
2,025⅜ bushels coal, at 8½ cents per bushel	.....	$172.15	
4,050 pounds ice, at 20 cents per cwt	.....	8.10	
20 gallons valve oil, at 65 cents per gallon	.....	13.00	
15 gallons engine oil, at 35 cents per gallon	.....	5.25	
3 gallons signal oil, at 50 cents per gallon	.....	1.50	
Total	214.67	200.00	$414.67
Alteration and repairs to plant	269.86	26.91	296.77
Building skiffs	56.25	.....	56.25
Roofing driver	6.00	33.06	39.06
Plant purchased: Ropes, lines, tools, handles, lanterns, oars, anchors, Vulcan hammer and pile driver, etc	.....	3,075.00	3,075.00
Towage	497.25	4.22	501.47
Hire of plant:			
1 steamer, 2½ days, at $15 per day	.....	.....	37.50
2 barges, 10 days, at $2 per day each	.....	.....	40.00
1 barge, 2 days, at $4 per day	.....	.....	8.00
Steam tender and 4 barges, 54 days, at $25 per day	.....	.....	1,350.00
1 barge, 4 days, at $1.50 per day	.....	.....	6.00
2 barges, 1 day, at $1.50 per day each	.....	.....	3.00
3 barges, 49 days, at $1.50 per day each	.....	.....	220.50
1 pile driver, 6 days, at $16 per day	.....	.....	96.00
1 pile driver, 47 days, at $8.50 per day	.....	.....	399.50
Total amount miscellaneous expenses	.....	.....	6,543.72

Cost of superintendency.

Classification.	Labor.	Expense.	Total.
Labor	$1,158.67	.....	
Traveling expenses	.....	$230.40	
Office rent	.....	51.90	
Telegrams	.....	23	
Telephone	.....	22,66	
Total	1,158.67	305.20	$1,463.87

RECAPITULATION.

Amount expended on dike construction	$7,210.56
Amount miscellaneous expenses	6,543.72
Cost of administration and superintendence	1,463.87
Grand total	15,218.15

APPENDIX J.

ANNUAL REPORT OF MR. SAMUEL H. YONGE, DIVISION ENGINEER, OSAGE DIVISION.

MISSOURI RIVER COMMISSION,
OFFICE OF DIVISION ENGINEER,
Jefferson City, Mo., June 30, 1895.

COLONEL: I have the honor to submit my report of the operations conducted under my charge on the work of improving the Missouri River on Osage division of the first reach during the fiscal year ending June 30, 1895, as follows:

SYSTEMATIC IMPROVEMENT IN FIRST REACH.

Project.—The dikes on which work was conducted and the projects of which they form parts are as follows, viz: Dike B of project of February 9, 1892; Dike 3 of project of April 16, 1891; Dikes 23, 25, 26, 27, 28, 29, 30, 31, 34, 34 A, 35, and 36 of project of March 21, 1893; Dike 36 B of project of September 6, 1894; Dikes 19 B, 29 A, 29 B,

33 B, and 33 C of project of May 1, 1895, and Dike 21 A, proposed July 26 and approved July 28, 1893. Besides the dike work enumerated above the outer end of Dike 19 A of the project of February 17, 1892, and of Dike 22 of the project of March 21, 1893, were reconstructed.

DIKE CONSTRUCTION.

Notice being received from your office October 15, 1894, to proceed with such work as could be advantageously carried on during the fall season, steps were at once taken to organize and send out a party, and dike construction was resumed October 22. On account of the lateness of the season only a few pieces of plant could be advantageously put in serviceable condition and a limited extent of improvement work constructed.

The fall operations were continued until December 19 and consisted of extending two of the Hord dikes, constructing a part of Dike 30, making necessary repairs to several of the dikes which had been damaged during the preceding high water, and repairing and raising Osage Chute Dam, parts of which had settled.

The river opened February 28 and active operations were resumed March 24, on which date the organization of a construction party, consisting of two dike parties, was completed. The organization of a second construction party was greatly delayed by the appearance of smallpox in the vicinity of Ewing boat yard, which made it undesirable to take on new men. A sufficient number of men, however, to constitute one dike crew was available, and the party was sent out April 5. The organization of the party was completed by the addition of another dike crew April 29, the necessary complement of men being gotten from other localities.

The stage of water during the entire year was unprecedentedly low and very favorable for conducting operations incidental to dike construction. The usual April rise did not occur and the June rise did not reach the stage of standard high water by about 5 feet. Work was carried on continuously until June 24. The total extent of dike constructed amounts to 1,232 feet of 2-row, 14,349 feet of 3-row, and 2,632 feet of 4-row dike, equivalent in the aggregate to about 18,693 feet of 3-row dike.

In placing dike piles steam hammers were used exclusively, this class of work being done by two Vulcan hammers, size No. 2, and two Cram hammers, size B. The work done by both makes of hammers proved highly satisfactory, deep penetrations being readily attained with great rapidity.

In the spring of 1894 a small quantity of wire netting was placed on a part of Dike 2 where the accretions had not built up to any extent. The result of this experiment was a building up of the accretions both above and below the dike where the net was placed, and was sufficiently satisfactory to warrant its further use instead of screening poles previously employed. The netting is made in sections 11 by 29 feet, 16 by 50 feet, and 22 by 29 feet. It is made with a pin twist, and has a triangular mesh 9 by 16 inches. No. 12 (B. W. G.) steel wire, annealed and galvanized, is used in its manufacture. Nos. 14 and 10 wire were experimented with, but were abandoned; the former having insufficient strength, the latter being too heavy to use in making the pin twist.

As each net is made it is for convenience of handling and storing rolled up, forming a bundle about 14 inches in diameter.

In attaching the netting to the dikes, one edge is stapled with wire nails to the upstream waling. It is also, in some instances, where considered necessary to prevent bagging, supported at the water line by three-eighths inch wire strand.

The details of dike constructed are essentially the same as those adopted during the fiscal year ending June 30, 1894, excepting that an extra pile was driven above and lashed with wire strand to each upper pile of the outer three bents of the dikes. The profiles of new dike work are shown on Pls. II, III, IV, V, VI, and VII.

White oak piles were used for the 200 feet at the stream end and the wing of the dikes, cypress piles almost exclusively for the inner portion.

Dike B.—As explained in a former annual report there were two gaps in Dike B, one of about 125 feet near the middle of the dike, the other of about 80 feet near the shore end, where it had been impossible to place piling on account of the inaccessibility of these parts to the jet-pile sinkers. On account of the small extent of land pile driving required for dike work, suitable plant for this class of work has not been provided. As it was considered desirable to close the above-mentioned gaps, a fence, the top and bottom strings of which consist of three-fourths inch strand and the two intermediate strings of three-eighths inch strand, was placed across them in November and December, 1894. At the gap near the middle of the dike the ends of the strands were made fast to two or three bents of piling on each side of the opening. The strands at the gap at the shore end were made fast to two bents of piling and to deadmen set on the bank. Posts were then set about 25 feet apart in line with the upper row of dike piles. These posts were further secured by three-eighths inch strand extending to deadmen placed about 100 feet above the dike. Wire netting was then attached to the fence strands.

Dike 3.—When Dike 3 was constructed in the fall of 1891 it could not be carried to the line of rectification on account of a low towhead projecting slightly above the line of the dike. The upper end of the towhead was, therefore, protected by a woven mattress revetment extending slightly below the line of the dike. During the flood of May, 1892, the part of the towhead above a low-water stage was washed away. The mattress revetment, however, remained intact, although it settled several feet. Early in April, 1895, a favorable opportunity offered for connecting with the old dike and extending it across the towhead to the line of rectification. The length of this extension is 169 feet.

Dike 19 B.—Observation of the effect of Dike 19 A during the June rise of 1894 in directing the flow toward the head of Côte Sans Dessein and preventing a return flow below Dike 19 A into Osage Chute showed that at least another point of resistance between Dike 19 A and the head of Dodds Island was necessary to accomplish the desired channel rectification opposite Barkersville. As there was no bank between Osage Point and Dodds Island against which a dike normal to the line of rectification could abut, it was proposed, in order to accomplish the above purposes and to protect the low-water dam across the head of Osage Chute when the Missouri is at a higher stage than the Osage, to construct a dike on a diagonal line from Osage Point toward Dike 22. The construction of Dike 19 B was begun 1,260 feet from its proposed shore end on the the edge of the accretions below Dike 19 A May 22. The outer 1,822 feet and 68 feet of 3-row wing were completed about June 10. The construction of the inner 1,260 feet was then proceeded with, the river having risen sufficiently for this to be done. While the latter work was in progress a large wrack heap formed above the dike 700 or 800 feet from its stream end.

A strong current along the line of the dike toward its shore end caused large sections of driftwood to break loose from the wrack heap and float down on to and under the foot mat in course of construction, which interfered considerably with the work. This difficulty was overcome by running out about 750 feet from its shore end above the dike a 2-row wing 58 feet long.

The structure is a 3-row dike with the exception of 568 feet about 270 feet from the stream end, which is a 4-row dike. White oak piles were used for the outer 600 feet and wing and cypress piles for the remainder of the dike. The outer 200 feet and wing have besides the usual bracing a system of horizontal diagonal bracing. The wing is placed askew to the dike and parallel with the line of rectification. It is to have a length, when completed, of 250 feet.

The dike was completed June 22, with the exception of 180 feet of the wing, which could not be constructed on account of the river being at too high a stage.

Dike 21 A.—As explained in my annual report of 1894, Dike 21 A could not, at the time of its construction August, 1893, be carried closer to the proposed line of rectification than 450 feet, as at that point the steamboat channel was reached and the deep water and swift current rendered further construction impossible. During the June rise of 1894 the desired effect of the dikes immediately above Dike 21 A was realized by the channel at this point being shifted to the line of rectification. As, during the fall of 1894, all the serviceable plant was required for carrying on more urgent works, the extension of the dike was not begun until April 11, 1895. The outer portion of the dike was completed to the line of rectification and a 70-foot wing placed under its stream end by April 22. The inner 136 feet of the pile structure has not yet been built, as a suitable stage of water has not occurred.

Dike 23.—The map of low-water survey of October, 1894 (Pl. I), accompanying this report, shows a crossing from the bar under Dike 22 about a half mile below that dike toward the outer end of Dike 26. In the spring of 1895 the position of this crossing was practically the same as during the previous fall. With a view to preventing this crossing and to training the flow along the face of Côte Sans Dessein Bluff the construction of the outer part of Dike 23 was decided on as a part of the spring operations. This work was begun at the shore edge of the bar about 1,100 feet from the main bank April 29. After the dike had been carried out 161 feet work had to be suspended May 2 until May 13 on account of reaching the channel. On the latter date work was resumed, and the dike extended 205 feet farther by May 18, when it had to be again suspended for the same reason as in the first instance.

A good connection was made between the pile work and the bar on which it abuts by carrying back the dike foot mat a distance of 68 feet. The portion of the dike constructed has two systems of horizontal bracing and a set of vertical diagonals.

Dike 25.—The construction of Dike 25 was begun April 19. Only the outer 345 feet of the pile structure could at that time be built on account of a flat bar extending from the north bank of Dodds Island a distance of about 2,200 feet. A 100-foot wing was placed under the stream end of the dike, and the dike foot mat extended back onto the bar a distance of about 245 feet. The above work was completed April 29.

On June 13 it was made possible by a higher stage of water to resume the construction of the dike, and the piles were placed and braced for a distance of 229 feet where

the foot mat had been previously extended back on the bar as described above. Work was suspended June 15.

Dike 26.—During the interval between October, 1893, and March, 1895, the position of the channel at Dike 26 had been changed sufficiently to make it possible to extend this dike to the line of rectification without obstructing the steamboat channel. This work was done between March 27 and April 23, 1895, the dike being extended a distance of 990 feet. The work still to be done on the dike to complete it comprises pile driving and bracing for a distance of about 400 feet near the shore end.

Dike 27.—After the effect of the high water following the construction of the inner 1,000 feet of Dike 26 in the fall of 1893 was observed, it was hoped, on account of the extensive accretions formed by that dike, that it might be unnecessary to extend Dike 27, the inner 219 feet of which had been built in July, 1893. In the spring of 1895, however, it became evident that the dike would have to be extended its full length, as the greater part of the volume of flow passed between a middle bar about halfway between the Côte Sans Dessein Bluff and Dodds Island and threatened to erode the north bank of the latter and flank Dike 28. Work was begun April 8 and a section of 871 feet of the dike completed by April 18. It was not possible to connect this work with that of July, 1893, on account of shallow water on the line of the dike for a distance of 545 feet, nor to extend it to the line of rectification on account of the middle bar referred to above. The stage of water remained too low to get the plant to the gap until June 13. On that date work was resumed and proceeded with until June 17, when the gap was closed. Although it was the intention to make the entire structure 3-row dike, 113 feet of it had to be made 2-row dike, as the water was too shallow to allow a driver to place the piles in the upper row.

Dike 28.—The work of extending Dike 28 was begun March 27, and the dike extended a distance of 587 feet, or to within 185 feet of the line of rectification. The outer 368 feet is 4-row dike. Work had to be suspended twice on account of the river rising above the level of the dike. After the second suspension, on April 8, the current became so swift and the depth of water from scour so great at the end of the work that a further extension of the dike during the spring was impracticable.

Dike 29.—In constructing Dike 29, in the fall of 1893, 505 feet near its shore end could not be completed on account of a sand bar, across which, however, the dike foot mat was made and ballasted. On April 10, 1895, the stage of water was high enough to permit a driver to be placed on the line of the dike and the pile driving and bracing in the gap to be proceeded with. The closing of the gap was completed April 15. It has not been practicable, on account of the deep water and swift current, to complete the outer part of this dike by extending it about 135 feet to the line of rectification.

Dikes 29 A and 29 B.—As the dikes of the Dodds Island group were extended, the shore bar below Côte Sans Dessein began to cut away, and there appeared to be a decided tendency for the river to follow an old slough on the left bank outside of the lines of rectification. To counteract this effect Dikes 29 A and 29 B were projected. The construction of Dike 29 A was begun May 14 and completed May 24. As the penetration of piles at the shore end was limited by bed rock to less than 20 feet, they were well anchored by filling in with stone ballast to about S. L. W.

The construction of Dike 29 B was begun May 21, about 137 feet from its proposed shore end, a foreshore preventing work being carried on for this distance at the inshore end of the dike. After the pile driving had been carried out a distance of 264 feet it had to be discontinued on account of reaching shallow water. The dike foot mat was extended back to the main bank and ballasted, and work suspended May 27.

Dikes 30 and 31.—Your verbal instructions to begin the construction of the portion of Dike 30 that was accessible were given November 6. About 900 feet of the dike was constructed between November 16 and December 7. Pile driving was begun 1,200 feet below Dike 29, on the lower side of the accretions formed by that dike. It was proposed to make the pile structure a 4-row dike, with heavy bracing, the arrangement of which is shown in Pl. VIII. This deviation from the usual form of bracing was made, as it was thought that the dike, on account of projecting into the channel without any backing of accretions, would, during the ensuing winter, be exposed to very severe stress from ice movement. The foot mat of this part of the dike was made unusually wide on account of the dike being placed directly across a part of the channel. It extends 52 feet above the upper line of piling and has a total width of 92 feet. It was found impossible, however, to adhere to the original design and make the entire structure a 4-row dike, and an offset had to be made in the lines of piling on the upper side of the dike 408 feet from the shore end on account of a bar forming while the work was in progress. This offset is 154 feet long and consists of 2-row dike. It covers a gap of 80 feet in the main dike. The work done on the dike during the fall consisted of constructing 151 feet of 2-row, 37 feet of 3-row, and 743 feet of 4-row dike. Its total projection from the bar is 909

feet. To prevent the pile work from being flanked by the erosion of the accretions against which it abuts a woven mattress sill 50 feet wide, heavily ballasted with stone riprap, was laid across the bar between it and Dike 29. The floating plant was sent to the boat yard to be stored December 14, and work on the dike suspended December 19. Considerable difficulty was experienced in conducting work on Dike 30 during the fall on account of the constant movement of sand reefs. This resulted in the floating plant frequently overnight getting hard aground, and made it necessary to lighten barges of material to get them afloat and to carry considerable of the material to the dike by hand longer distances than usual.

When pile driving was resumed April 23, it was impossible, on account of shallow water and a low flat bar, to get the drivers closer to the pile structure constructed in December than 843 feet. A woven sill 70 feet wide was, however, placed across this gap and heavily ballasted, the pile driving and bracing being deferred until they could be economically carried on at a higher stage by using the floating plant. The construction of this dike was proceeded with until May 26, on which date it had been carried as far as possible without encroaching on the steamboat channel. The portion of the dike constructed during the spring consists of 3-row dike with a foot mat 70 feet wide. Its length is 1,684 feet. A fourth row of piles, 602 feet long, beginning 565 feet from the lower end of the dike, where the current was unusually strong, was subsequently added. A 3-row wing, 40 feet long, was placed above the dike 28 feet from its end, and another 565 feet from its end. This latter extends 52 feet above and 29 feet below the dike. The purpose which the wings are designed to serve is to prevent strong currents from following the line of the dike and causing scour. On May 19, 20, and 21 a slight rise in the river made it possible to place a steam driver in the gap left in the spring and to drive piles for a distance of 281 feet. Another rise on June 9 made it possible to again resume work in the gap, which was closed June 13.

Simultaneously with beginning work on Dike 30 in the spring the construction of the part of Dike 31 which it was proposed to place above Dike 30 was begun. This dike was carried to the channel, a distance of 450 feet from Dike 30. The dike was also extended 37 feet below Dike 30. No unusual difficulties were encountered in conducting spring work on dikes 30 and 31. A constant watch, however, had to be kept of the changes in the channel above the dikes and great caution observed so as not to extend Dike 30 across it. As Dike 30 was extended a reef formed below it, the effect of which, in connection with that of Dike 31, was to keep the channel of the river above it.

Dike 33 B.—The construction of Dike 33 B was begun June 3, and was proceeded with until June 9, when a rise in the river and floating driftwood compelled a suspension of work. Work was resumed June 10, but had to be again discontinued June 11, on account of a further rise in the river, which brought the water to the top of the piling. The dike extends 573 feet from the shore. It has still to be extended 177 feet to reach the proposed line of rectification.

Dike 33 C.—The construction of Dike 33 C was begun May 27. The work was carried on without interruption until June 7, on which date the dike was completed.

Dike 34 A.—On account of a foreshore 284 feet wide on the line of Dike 34 A, the pile driving for the dike was begun at that distance from the shore. The construction of the dike and a 50-foot wing under its stream end was completed May 19, with the exception of the pile driving and bracing of the inshore portion above noted. On this date the river had attained a sufficiently high stage to allow six bents of piling to be placed at the shore end. Work was then suspended until June 10, when a higher stage of water permitted the plant to be brought to the gap, which was closed June 12.

Dike 35.—Pile driving at Dike 35 was begun November 3, and the dike extended 456 feet. Work was suspended November 13, on which date the dike had been carried to within about 225 feet of the line of rectification. It was deemed injudicious to construct this outer portion of the dike on account of the risk that would have been incurred by exposing new work in the main channel to ice movement in the spring. The extension of this dike is a 3-row structure of the same design as the part previously constructed.

Dike 36.—The work of extending Dike 36 was begun October 27 and suspended November 20. The dike was extended 956 feet. It has still to be carried about 350 feet. The latter part of the dike was not constructed during the fall, for the same reason as that given for Dike 35.

Dike 36 B.—The construction of Dike 36 B was begun at its shore end October 26. It was possible to construct only 358 feet of the dike on account of shallow water. The structure consists of 3-row dike with two systems of bracing. Work was carried on continuously until November 6.

The total number of piles driven for dike work in conducting the year's operations amounts to 6,205. Of this number 5,733 were driven in the dikes proper, to an aver-

age penetration of 25.035 feet, the remaining 472 being mooring piles. The pile-driving data for each dike are shown in the following statement:

Letter or number of dike.	Number of piles.	Average penetration.	Letter or number of dike.	Number of piles.	Average penetration.
		Feet.			*Feet.*
C	17	28.0	29A	* 168	25.4
D	7	26,0	29B	90	22.9
3	58	23.7	30	1,244	24.5
19A	168	26.2	31	166	23.5
19B	999	26.4	33B	166	24.2
21A	149	26.2	33C	221	24.7
22	80	25.6	34	40	25.2
23	115	24.5	34A	169	24.7
25	198	25.6	35	147	24.5
26	329	25.0	36	300	24.4
27	422	24.4	36B	114	22.1
28	215	24.0			
29	151	24.5	Total	5,733	25.035

* Twelve piles driven to bed rock not included in making average.

The extent of completed dike work is given in the following table:

Group.	Number or letter of dike.	Length in feet.				Total.
		1-row.	2-row.	3-row.	4-row.	
Osage	3	*a* 9	*b* 20	159	.....	188
	19A	.....	*c* 21	*a* 104	289	414
	19B	.....	*a* 58	*d* 2,545	568	3,171
Total	.....	9	99	2,808	857	3,773
Barkersville	21A	.....	*a* 69	436	.....	505
	22	.....	*a* 100	134	41	275
	23	.....	*a* 19	366	.....	385
Total	.....	.....	188	936	41	1,165
Dodds Island	25	.....	99	574	.....	673
	26	.....	*a* 85	*e* 1,000	.....	1,085
	27	.....	*f* 113	1,303	.....	1,416
	28	.....	.....	219	368	587
	29	.....	.....	505	.....	505
Total	.....	.....	297	3,601	368	4,266
Côte Sans Dessein	29A	.....	*a* 84	482	21	587
	29B	.....	*a* 31	264	.....	295
Total	.....	.....	115	746	21	882
Bonnots Mill	30	.....	*g* 297	*h* 2,084	1,345	3,726
	31	.....	*a* 20	486	.....	506
Total	.....	.....	317	2,570	1,345	4,232
Periguey	33B	.....	.....	573	.....	573
	33C	.....	*a* 97	657	.....	754
	34A	.....	*a* 47	603	.....	650
Total	.....	.....	144	1,833	.....	1,977
Hord	34	.....	.....	*i* 108	.....	108
	35	.....	*a* 30	456	.....	486
	36	.....	*a* 31	956	.....	987
	36B	.....	*a* 31	335	.....	366
otal	.....	.....	92	1,855	.....	1,947
Grand total	.....	9	1,252	14,349	2,632	18,242

a Wing.
b 10 feet is wing and 10 feet extension.
c Connection between old and new work.
d 68 feet is wing.
e 990 feet main dike, 10 feet wing.
f 113 feet main dike.
g 95 feet connection, 202 feet main dike.
h 1,974 feet main dike, 110 feet wing.
i 108 feet washed out and broken down, strengthened and reconstructed as 4-row.

(See Exhibit A.)

DIKE REPAIRS.

During every high water or breaking up of the ice in the spring the stream ends of some of the dikes are damaged to a greater or less extent. This is particularly the case with dikes situated in the concave sides of bends. It therefore appears to be absolutely necessary, in order to hold the river on certain fixed lines, to make such dikes as are exposed to the destructive influences above referred to permanent up to a low-water stage. The only economical method that offers for doing this is to make a solid head to the permeable structure between the shore line of the accretions and the stream end of the dike, or line of rectification, by filling in with alternate layers of brush mattress and stone ballast, to form a submerged spur at navigable stages. The length of these heads will vary from about 75 to 150 feet, depending upon the curvature of the bend in which the dikes are situated and the angle of incidence of the current with the dike. It is found that accretions formed by dikes situated as above described do not reach to the extreme ends of the dikes by about the distances named. If the above precaution is not taken and improvement work is ever suspended for a few years, so that the necessary repairs to the stream ends of the dikes can not be kept up, erosion of the accretion formed by the dikes will follow the wrecking of their stream ends, exposing another section of dike to the same influences that caused the destruction of the original stream end. This will be followed by a still further erosion of the accretions, and this action will be kept up until the whole dike has been wrecked, the accretions washed away, and the river returned to the position it occupied before improvement. The remains of the structure will thus become obstructions to navigation, as stumps of piles will be left standing under water. The plan of constructing solid heads to dikes may be objected to on account of their forming eddies which will wash away the accretions. Observation of permeable dikes, however, shows that they cause accumulations of large quantities of driftwood, which make the dikes practically solid, and create a head resulting in eddy action nearly, if not quite, as severe as that produced by solid dikes.

The dikes which undoubtedly require the treatment suggested are B, C, D, 10, 11, 17, 17 A, 18 A, 19 A, and 19 B. It is thought probable that as the improvement advances it will become necessary to protect similarly other dikes on the reach. It was found absolutely necessary to fill in the outer end of Dike 9 with brush mattress and stone ballast, to make the plant laid up behind it in the winter time safe against the movement of ice gorges.

Dikes C and D.—While the river was at a high stage in June, 1894, severe scour occurred at the stream end of Dikes C and D. The foot mat settled as the scour occurred, and several of the piles in each of the dikes were washed out and broken. A number of piles and braces at the outer end of Dike D were broken off by the Jefferson City ferryboat running into the dike during a fog. In the fall of 1894 the piles which had been washed out and broken off were replaced and the dike reenforced by driving two piles instead of one in the upper line of piling of the outer three bents. The outer 140 feet of Dike C and 105 feet of Dike D were lowered, to reduce the exposure and liability of being broken down by driftwood and ice. Considerable damage was done to this repair work by the ice in the spring of 1895, and the stream ends will, during the next low-water stage, have to be again repaired.

Dike 1.—A breach 60 feet long was made near the stream end of Dike 1 during the June rise of 1894. As this part of the dike was inaccessible to the floating plant during the fall of 1894, it was only possible to make temporary repairs, and the breach was closed by constructing a net and cable fence similar to that employed in closing the gaps in Dike B.

Dike 9.—The filling in of Dike 9, previously adverted to, was done in December, and consisted of placing two layers of continuous frame mattress within the lines of piling for a distance of 60 feet at the stream end of the dike and 30 feet in the wing and ballasting heavily each layer with stone, bringing the filling slightly above S. L. W.

Dike 17.—Seven piles and a number of braces in the stream end of Dike 17 were broken by the ice in the spring of 1894. The outer 132 feet between the line of the accretions and the stream end of the dike was lowered so as to reduce dike exposure. The broken piles were replaced and three extra piles driven immediately above the upper piles of the outer three bents and lashed to them with wire strand.

Dike 19 A.—During a rise in April, 1894, the outer portion of Dike 19 A was destroyed. Although it would have been possible to have reconstructed this part of the dike in the fall of 1894, it was deemed inadvisable to do so, on account of the great risk that would have been run during the ensuing winter from ice movement, to which the new work, on account of its exposed position, would have been subjected. The outer bents having become weak from excessive scour, reenforce piles were driven in December above the upper row and lashed to the dike piles with wire strand. A short pile buttress was also placed below the stream end of the dike. The work of replacing the destroyed portion was begun May 6 and the dike

extended 290 feet, or to its proposed end, by May 14. An offset of 20 feet was made between the old and the new works, the latter being placed that distance above the former and their ends connected by a 2-row dike. The new work is 4-row dike. Heavy white-oak piles, with an extra system of horizontal bracing, were used in its construction. A 3-row wing, 106 feet long, was placed under its stream end. The old dike was reenforced for a distance of 80 feet by placing behind it a fourth row of piling.

Dike 22.—Dike 22 was constructed in August, 1892, to within 80 feet of the line of rectification. Its stream end has been exposed to severe stress during each flood and breaking up of the ice. Slight repairs were made to the stream end in the spring of 1894. During the June rise of 1894 and the opening of the river in the spring of 1895 about 100 feet at the stream end of the dike was practically destroyed. Between April 11 and 22 the part of the dike which had been destroyed was reconstructed and the dike extended to the line of rectification. It has a 100-foot wing under its stream end. White-oak piles were used for the dike and wing, excepting for four bents, where the dike crossed deep water at its old end, for which, no oak piles of sufficient length being available, cypress piles had to be used. All of the new work and the wing received the regular bracing, besides horizontal diagonals. The repairs to and extension of Dike 22 were carried on simultaneously. The cost of the work is shown under the respective headings of construction and repair.

Dike 34.—A breach was made near the outer end of Dike 34 during the high water of June, 1894, which was the result of an accumulation of driftwood above the dike, causing severe scour. The repairs consisted of reconstructing about 80 feet and repairing about 27 feet. (See Exhibit B.)

RESULTS OF DIKE WORK.

The channel improvement on the reach, accomplished since 1891 and described in former reports, has remained practically unchanged. The changes effected by the new work during the last twelve months, by increasing the area of proposed new channel and filling up old channels by the formation of accretions around the dikes, are not as extensive as those accomplished in previous years by similar works. It is not possible to present data showing the changes in tabulated form, as was done in former reports, as they, for the most part, have occurred during the present month, which has not allowed sufficient time to complete and arrange the data. The changes that have occurred are indicated on Pl. I, and may be described in a general way as follows: The reef on the Barkersville Crossing, which for several years has been a great obstruction to navigation, had by May 1 been almost obliterated, and it is very improbable that it will ever re-form. The channel rectification has been extended from Barkersville to the foot of the Côte Sans Dessein Bluff, a distance of about 2¼ miles. The channel between Dodds Island and the Côte Sans Dessein Bluff has been moved from the former toward the latter, a distance of about 1,200 feet, and the crossing from the foot of the bluff toward Bonnots Mill has, through the influence of Dikes 30 and 31, been moved downstream a distance of 3,500 feet. Although the above improvement is not complete, the progress made in channel rectification warrants the opinion that the projected improvement of the portions of the river referred to will, in the near future, be consummated.

All of the older accretions formed by the dikes between Cedar City and Isbell are now covered with a good growth of willows. This will in future floods cause a still further building up of the accretions, which in many cases have already attained an elevation of about a six-tenths stage.

The formation of a middle ground opposite the Cedar City group of dikes, and of a similar formation in front of Dikes 10 and 11, during the low-water season between November, 1894, and March, 1895, may be taken as an indication that a greater contraction in bends than 1,000 feet is desirable.

OSAGE CHUTE DAM.

During the June rise of 1894 the Osage River remained at a lower level at the dam than the Missouri. In consequence of this condition there was a steady flow from the Missouri over the dam into Osage Chute, with the thread of the current about 700 feet from the head of Dodds Island. As described in my last annual report, a ballasted mattress sill was placed across the bar between the head of Dodds Island and the east end of the dam proper, a distance of about 900 feet. An examination of the dam in connection with a line of levels taken along its crest October 18 and 19, 1894, during a low stage, showed a subsidence of 1 to 2 feet of the greater part of the dam and the sill across the bar, a scour under the bar sill of 5 to 7 feet for a distance of 260 feet, where the thread of the current crossed it during the preceding June rise, and a scour of 4 to 5 feet under the dam proper for a distance of 175 feet, beginning 740 feet from its west end. The effect produced by the dam during the

June rise of 1894 was the formation, both above and below it, of irregularly shaped bars of sand and gravel. About 3,500 second-feet of water, or 15 per cent of the discharge of the Missouri River (stage S. L. W.) flowed through and over the dam into Osage Chute. The greater part of this water passed through the two larger depressions with a very high velocity, the difference in level of the water surface above and below the dam being about 3 feet. The dam, however, was inaccessible to floating plant, the water escaping at it reaching and leaving it through shallow, tortuous channels between the bars. Arrangements were made for the delivery of a supply of stone at Osage Point, and a plank roadway laid on the braced piling at the west end of the dam. The crest of the dam was cleared of driftwood which had accumulated and formed a number of wrack heaps. Brush was then gotten to the dam by teaming a distance of half a mile across a bar above it and over a short bridge, erected for this purpose, between the bar and the dam. A frame mattress 19 feet wide and 14 inches thick was then laid along the crest from the east end of the plank roadway to the large depression in the dam, and sand hauled out and placed on it to make a roadway for the teams.

These preparations were completed and the work of raising the dam to an elevation of 3 feet above S. L. W., or 1 foot above its original level, was begun November 3. Stone was teamed from the west end, and the depression filled to the surface of the water, after which the mattress and sand roadway was extended to the depression in the sill. This depression was also filled with stone and the mattress extended across it. As an extra precaution against scour two thicknesses of woven mattress, 30 feet wide, were laid on the upper or Missouri River side of the stone fill last mentioned and heavily ballasted. A layer of stone 2 feet thick and 13 feet wide was then placed on the frame mattress for its entire length, the stone being laid with some degree of regularity, and small stones driven into the interstices between the larger ones. Portions of the rest of the sill across the bar were evened up by filling in with brush and stone. The raising of the dam and necessary repairs were completed December 19.

After the river opened, the dam was frequently examined. In the early part of March it was found that about 260 feet of the dam west of and 30 feet of the sill east of the large depression in the sill that had been filled in November, 1894, had slightly sunk. A woven mattress 25 feet wide was placed against the Missouri River face of the dam, where the sinking has occurred, and ballasted. While the Missouri River was at a stage of about 2 feet above the crest of the dam, during the month of May, 1895, a portion of the bar at the head of Dodds Island cut out above the sill, resulting in a slight settling of about 200 feet of the latter east of the depression in the sill that had been filled in during the fall of 1894. As it was impossible to get floating plant to this point on account of shallow water, no steps could be taken to make repairs. On June 1 it was found that about 100 feet under the sill had settled to such an extent as to allow the passage of about 10,000 second-feet of water. On June 3 it was found possible for the steamer *John R. Hugo* to pass through the breach, and steps were at once taken to get the necessary plant and material to the dam. The breach continued to enlarge by deepening, until a depth of 25 feet was attained. As it appeared to be impracticable to restore the dam on its original line, on account of the swift current and deep water, the expedient was resorted to of placing, about 160 feet above the breach where the water was from 10 to 15 feet deep, a braced pile structure of two lines of piling, with a foot mat, 60 feet wide, carrying a woven mattress screen on the Missouri River side. The lines of piling are 20 feet apart in 10-foot bents. They begin at the bar at the head of Dodds Island, and overlap the end of the dam about 140 feet at the west end of the breach. The heads of the piles are braced longitudinally with 6 by 8 inch timbers, and laterally with 5 by 8 inch timbers. The foot mat extends 20 feet above and 20 feet below the piling; it was also extended along the shore line of the bar below the east end of the pile structure a distance of 70 feet, to prevent flanking. The pile structure and foot mat were completed June 13, when, the plant being required for other urgent work, this work was temporarily suspended. The carrying on of the work was attended with considerable difficulty on account of the swift current.

Between June 18 and 21 the woven mattress screen, which is 50 feet wide, was placed. It extends from the dam around the pile structure and over the bar to the old sill. The downstream edge of the screen was made fast to the tops of the upper line of piling and the upper 35 feet ballasted and sunk. Its effect was to completely shut off the flow through the breach in the old work. Stone ballast was then thrown between the lines of piling to a depth of 2 or 3 feet, and work suspended June 22. The expenditure on account of Osage Chute Dam during the fiscal year amounts to $13,184.03.

REPAIRS TO MURRAYS BEND REVETMENT.

The river in Murrays Bend is divided into two chutes by an island. The main chute, containing the steamboat channel, follows the left bank of the bend. The secondary chute flows below the island and, at or above a mid stage, joins the main

chute about 4,000 feet above the foot of the bend. When the river is at low stage the chutes unite about 3,000 feet lower down. In either case the effect of the confluence is eddy action, which has caused slight settling of parts of the revetment in the lower part of the bend. Slight repairs to the upper bank were made in the fall of 1894 and the spring of 1895 by removing the stone ballast and fairing up the slope by filling in with brush and straw, on which the ballast was relaid. In June, 1895, two breaches, about 130 and 100 feet long, situated 1,500 and 900 feet, respectively, above the lower end of the bend, occurred. The sloped bank in the breaches settled and formed holes about 35 feet wide, 5 to 6 feet deep, and of the lengths stated above. On June 21 a working party was sent to the bend and the holes faired up by driving a line of piling on the old shore line. A woven mattress was then laid in front of the piling and anchored to each pile by three-eighths-inch strand. The mattress was extended to the back of the cut and ballasted. Heavy walings were attached to the piling, the tops of which latter extend to high-water mark. The repairs were completed June 24, by attaching to the piling a brush fence composed of wire netting and willows. The cost of repairs to Murrays Bend revetment amounts to $1,545.50.

CONSTRUCTION MATERIAL.

The stone used for construction of improvement works during the fiscal year was procured by purchase in the open market. The points of delivery and number of cubic yards delivered at each point are as follows, viz: 6,652 at Côte Sans Dessein, 5,000 at Osage Point, and 3,344 one-half mile below Bonnots Mill.

The willow brush was cut from patches between Dodds Island and Boonville. The average length of tow was 40 miles.

One hundred and fifty-three thousand three hundred and sixteen feet, B. M., of long-leaf pine lumber for dike bracing were purchased, delivered f. o. b. cars at the Bonnots Mill material depot, and 76,080 feet, B. M., transferred from the Gasconade division, received on barges at Gasconade. There were also received from Gasconade division 19,002 pounds of bolts, 900 pounds of washers, and 81,370 linear feet of white-oak piling.

The appended statement shows the quantities of construction material on hand at beginning and close of the current fiscal year, quantities procured and expended, and the average cost per unit. (See Exhibit C.)

STEAMBOAT SERVICE.

In conducting operations in the fall of 1894, the steamers *Melusina*, *Doris*, and *John R. Hugo* were employed. The *Doris* from November 20 to December 14, and the *Melusina* from September 20 to November 9. The *John R. Hugo* was chartered at $40 per day, without fuel, October 18, and was employed towing willow brush and moving plant until December 11. In conducting spring operations, the above boats were employed, also the steamer *Atalanta*, which was towed from Gasconade to Ewing boat yard November 10. The *Atalanta* was put in commission April 29, and was used principally for towing lumber and piling from Gasconade to the material depot at Bonnots Mill. The *John R. Hugo* was chartered March 18, and was used almost continuously until June 21, when she had to be laid up on account of burning her boiler. She was used for towing brush and moving the larger pieces of plant. The *Melusina* and *Doris* were put in commission on March 26, and March 6, respectively, and were used for miscellaneous towing for the two construction parties.

CONSTRUCTION, REPAIR, AND CARE OF PLANT.

Plant construction.—Alterations were made in pile-sinker pump boats Nos. 4 and 8 by removing their pumps and rearranging their other machinery to adapt them for service with Vulcan steam hammers, and a set of leads framed and erected on the bow of each boat. The stiffening trusses of the boats were also modified to meet the strains imposed by that service. A 5,000-gallon water supply tank was erected at Ewing boat yard, and seven skiffs built. Stack knees were set up on the steamer *Atalanta*, name boards made and painted, lockers put up in cabin, storm bulkheads placed around the boiler, the steering apparatus completed, a steam capstan and two hand capstans set up, the whole boat given one coat of paint and slight alterations made in her fire bed, stacks, etc. Five bracing pontons, 7 by 24 by 2 feet deep, and five mattress pontons, 7 by 16 by 2 feet deep, were constructed. Four sets of hinged skids were placed on a 100-foot barge; also a boiler and a double steam winch with tackle. This apparatus was designed for unloading onto the river bank bracing lumber and piling received on barges at the material depot at Bonnots Mill. The telephone line between Jefferson City and Ewing boat yard was extended to Bonnots Mill. A reserve set of leads adapted for use with either Vulcan or Cram ham-

mers was framed. These leads are intended to be used in event of any accident occurring to those now in use with either of the above makes of hammers.

Plant repairs.—In September and October, 1894, eight 100-foot barges and two 64-foot barges were sufficiently repaired to make them serviceable for fall operations. Considerable repairs were made to grader No. 8 carrying a Cram hammer, sunk by striking a snag in May, 1894. Brush quarter boats Nos. 7 and 8, construction quarter boat No. 3, steamer *Doris*, and machine boat No. 1 were recalked. The repairs and launching of the above boats were completed November 3.

In the winter of 1894–95 the hulls of graders Nos. 5 and 8 were repaired and the gunwales sheathed with 2-inch oak.

All of the barges belonging to this work, excepting those constructed during the last fiscal year, were constructed in 1882 and 1883, and although many of them had been repeatedly repaired further repairs were found necessary. It was proposed to make such repairs as would probably make the barges serviceable for two years by sheathing such decks, rakes, and sides, as required in this class of repair. The head blocks, plank sheers, grub strakes, and timber heads were repaired in as inexpensive a manner as possible and the barges strengthened laterally by placing a cross chain from outside to outside of gunwales at the timber heads at each end of each barge. A supply of 2-inch pine for sheathing was procured in February and March. This lumber was surfaced and outgauged at the boat-yard mill. A further supply of lumber was procured in May and June for completing the repair work.

Repairs of the above character were made to thirty-four 100-foot barges and nine 64-foot barges. Such of the old oakum as was found defective was removed from the seams of all the plant, which was thoroughly recalked.

Two longitudinal trusses were placed on the steamer *Doris*, and her engine timbers reenforced by bolting a 6 by 16 inch pine timber 32 feet long to each of the old timbers, and wrought-iron engine frames substituted for the cast frames, which had proved to be too weak.

The upper works of the steamer *Melusina* were renewed; the inside and outside of the hull plating thoroughly scraped, cleaned, and painted; new tubes put in heater; a new pillow block placed on port engine pedestal; the bed plates for her engine strengthened with tie rods; fire liners replaced; feed pump repaired; rudder strengthened, and other miscellaneous repairs made. Barge No. 8 with quarters was thoroughly repaired, and bunks set up in cabin for use of survey party engaged in making a topographical survey of First Reach, under the direction of the secretary of the Commission. The boat was launched October 20.

Extensive repairs were made to both of the Cram hammers.

In constructing the original ways at Ewing boat yard, piling which had been in use at the Quindaro, Kans., boat yard was employed for the main line of storage tracks. By the fall of 1894 all of these piles had deteriorated to such an extent as to render the tracks unsafe, and it therefore became necessary to reconstruct about 500 feet. This line of tracks was also extended 70 feet, and the middle line of tracks 50 feet, to accommodate new plant. About 200 linear feet of the incline portions of the ways were widened, so as to accommodate the towboat *Wm. Stone* in event of its being finally decided to place her on the ways.

All the skiffs, forty-four in number, which had been stored in the skiff house during the winter, were overhauled, repaired, and calked.

The launching of plant was begun March 4, and, for the greater part, completed April 15. There still remain on the tracks four 100-foot barges and one hydraulic grader, which could not be launched on account of the failure of dealers to furnish, on time, the lumber required for making the necessary repairs. (See Exhibit D.)

Care of plant.—In October, 1894, the deposit under water, formed by Dike 9 on top of the ways at Ewing boat yard, was washed out in part by working the wheel of the steamer *John R. Hugo*; the portion above water was removed by horse scrapers operated by power furnished by the steam capstan of the steamer *Melusina* and steam windlass on grader No. 5.

The laying up of the plant used during the fall of 1894 was begun December 7 and completed December 15. The following pieces were pulled out on the ways and stored, viz, steamers *Melusina*, *Doris*, and *Atalanta*, machine boat No. 1, construction quarter boat No. 3, five single-deck quarter boats, ten 100-foot barges, eleven 64-foot barges, one pile sinker, four pile-sinker tenders with tower leads and two hydraulic graders carrying steam hammers. The division office boat was left in the river under Dike 9 during the winter. After the plant was laid up on the ways, all hulls were thoroughly cleaned out.

The steamer *Wm. Stone* was left lying in the Osage River during the winter, with two barges placed above to protect her from running ice in the opening of the river in the spring. The boat required considerable attention to keep her afloat on account of being leaky. During the extreme cold weather the water leaking into the boat formed ice before it could be pumped out, and it became necessary to place stoves in the hold and keep fires up for several weeks, also to thoroughly salt the hull.

Channels were cut in the ice around the *Wm. Stone* and her barges, also from the bluff above Dike 9 down to Dike 10 in the Missouri River.

The ice in the Osage River went out February 24, without doing any damage to the plant. The ice gorged between Jefferson City and Ewings Landing began to move at 3 a. m., February 27, and cut down mooring piles at the boat yard and piles in wing of Dike 9. The ice from above Ewing packed into the gorge between Dikes 9 and 10, causing the river to rise slightly and the south bank of the tow-head, opposite Ewing, to cave. The ice gorge between Dikes 9 and 10 remained intact until 5.20 p. m., of February 27, when the ice gorge above Jefferson City, giving way, came down on that at Ewing, caused the river to rise slightly, and started the gorge, which finally went out during the afternoon of the 28th, without doing any damage to office boat or dikes.

In April, 1895, the *Wm. Stone* was brought to Ewing boat yard in tow of the steamers *John R. Hugo* and *Melusina*. (See Exhibit E.)

SURVEYS.

The usual low-water survey was made, in the fall and early winter of 1894, of the reach between the head of Stanley Island and the foot of St. Aubert Bend. A reduced copy of the map of this survey is shown on Pl. I. The bluff contours and other interior topography are from the map of topographical survey made about the same time by Assistant C. M. Winchell, under the direction of the secretary of the Commission.

Several special surveys, to ascertain changes in the channel and shore lines, were also made, and the regular sounding of the established ranges of the reach under improvement kept up.

Very respectfully, your obedient servant,

SAML. H. YONGE,
Division Engineer.

Lieut. Col. CHAS. R. SUTER,
Corps of Engineers, U. S. A.,
President Missouri River Commission.

EXHIBIT A.

Detailed statement of driving mooring piles.

Number of dike.	Extent of work (number of piles).	Quantities of material.				Cost.		
		Native oak piles.	White oak piles.	Cypress piles.	Coal.	Material.	Labor and subsistence.	Total.
		Lin. ft.	*Lin. ft.*	*Lin. ft.*	*Bushels.*			
19B	100	940	1,155	1,611	160¾	$544.71	$178.38	$723.09
21A	14	.....	36	444	41	74.00	21.82	95.82
22	4	145	.....	.....	6	16.17	12.04	28.21
23	22	472	.....	358	50	107.05	57.96	165.01
25	12	400	.....	80	30	57.56	22.01	79.57
26	25	756	.....	.....	55	87.10	41.95	129.05
27	42	1,436	.....	.....	70	161.36	68.45	229.81
28	24	790	.....	.....	60	91.34	56.71	148.05
29A	16	.....	.....	550	40	82.78	28.95	111.73
29B	8	276	.....	.....	20	31.79	18.00	49.79
30	80	2,566	.....	128	235	319.54	229.24	548.78
31	14	488	.....	.....	39	56.64	31.76	88.40
33B	27	972	.....	.....	35	107.77	44.91	152.68
33C	20	678	.....	.....	36	76.55	28.83	105.38
34A	12	360	.....	.....	40	43.11	36.50	79.61
35	15	492	.....	.....	50	58.37	19.59	77.96
36	26	776	76	.....	95	106.93	103.62	210.55
36B	11	384	.....	.....	25	43.89	29.72	73.61
Total	472	11,931	1,267	3,171	1,087¾	2,066.66	1,030.44	3,097.10

Average cost of driving one mooring pile, $2.18+. Total average cost of one mooring pile driven, $6.56+.

Detailed statement of driving dike piles.

Number of dike.	Extent of work (number of piles).	Quantities of material.				Cost.		
		Native oak piles.	White oak piles.	Cypress piles.	Coal.	Material.	Labor and subsistence.	Total.
		Lin. ft.	*Lin. ft.*	*Lin. ft.*	*Bushels.*			
3	58	.....	.....	2,068	75	$302.32	$100.57	$402.89
19B	999	.....	10,236	29,242	762	5,984.25	914.33	6,898.58
21A	149	108	2,406	2,766	125	828.89	123.34	952.23
22	36	.....	1,089	371	40	243.00	61.75	304.75
23	115	.....	.....	5,060	140	734.58	137.29	871.87
25	198	144	4,398	2,334	180	1,117.49	206.41	1,323.90
26	329	.....	2,772	9,244	410½	1,832.80	286.57	2,119.37
27	422	.....	.....	16,468	465½	2,391.87	308.74	2,700.61
28	215	.....	602	7,858	320	1,255.54	208.07	1,463.61
29	151	.....	.....	5,286	120	764.27	103.46	867.73
29A	168	.....	2,944	3,508	200	1,023.26	173.92	1,197.18
29B	90	.....	.....	3,480	180	515.13	72.71	587.84
30	1,244	2,015	7,941	35,528	1,503	6,787.64	1,312.57	8,100.21
31	166	.....	.....	6,452	230	942.76	140.86	1,083.62
33B	171	200	240	6,328	220	986.21	103.43	1,089.64
33C	221	.....	3,352	5,418	250	1,369.75	187.81	1,557.56
34A	199	.....	1,974	5,360	255¾	1,127.32	244,38	1,371.70
35	147	130	684	5,104	200	878.38	149.40	1,027.78
36	300	.....	798	10,578	355	1,679.05	347.06	2,026.11
36B	114	570	.....	4,192	105	668.03	115.28	783.31
Total	5,492	3,167	39,436	166,645	6,136¾	31,432.54	5,297.95	36,730.49

Average cost of driving one dike pile, $0.96 +. Total average cost of one dike pile driven, $6.69 —.

Detailed statement of weaving foot mat.

Number of dike.	Extent of work.	Quantities of material.				Cost.		
		Brush.	⅜-inch wire strand.	⅝-inch clamps.	No. 10 wire.	Material.	Labor and subsistence.	Total.
	Square feet.	*Cords.*	*Feet.*	*Pounds.*	*Pounds.*			
19B	186,845	1,034½	27,550	70	171	$1,904.28	$1,552.04	$3,456.32
21A	35,155	211	5,000	6	43	383.30	227.41	610.71
22	6,373	52½	900	3	11	92.65	64.75	157.40
23	36,629	195	5,375	20	25	360.47	309.80	670.27
25	41,515	245	5,100	10	30	438.87	338.24	777.11
26	71,840	438	14,700	29	.....	828.59	641.19	1,469.78
27	78,012	444	15,500	36	.....	845.06	644.37	1,489.43
28	36,600	237	7,300	12	.....	444.90	413.12	856.02
29A	38,895	241½	6,500	25	25	444.99	354.80	799.79
29B	26,796	176½	4,000	4	.....	318.01	246.41	564.42
30	336,552	2,047½	46,700	62	20	3,692.68	3,019.48	6,712.16
31	36,640	221	5,300	5	.....	400.55	247.55	648.10
33B	23,772	210½	2,650	.....	.....	361.89	244.41	606.30
33C	49,319	278	6,000	2	.....	498.28	430.81	929.09
34A	41,809	255	2,500	5	.....	432.84	515.39	948.23
35	32,355	275½	4,300	10	10	481.09	292.36	773.45
36	62,881	583	10,200	19	21	1,026.88	624.94	1,651.82
36B	25,862	168½	4,800	15	.....	311.99	269.85	581.84
Total	1,167,850	7,314	174,375	333	356	13,265.32	10,436.92	23,702.24

Average cost of weaving 100 square feet, $0.89 +. Total average cost of 100 square feet woven, $2.03 —.

Detailed statement of ballasting foot mat.

Number of dike.	Extent of work.	Quantities of material.	Cost.		
		Stone.	Material.	Labor and subsistence.	Total.
	Square feet.	*Cu. yds.*			
19B	186,845	1,370	$1,276.88	$483.98	$1,760.86
21A	35,155	171	159.38	94.87	254.25
22	6,373	87	81.09	42.98	124.07
23	36,629	316	294.52	103.01	397.53
25	41,515	324	301.98	137.78	439.76
26	71,840	531	494.91	160.79	655.70
27	78,012	756	704.61	132.49	837.10
28	36,600	324	301.98	200.17	502.15
29A	38,895	318	296.38	88.88	385.26
29B	26,796	172	160.30	80.17	240.47
30	336,552	2,259	2,105.45	941.90	3,047.35
31	36,640	344	320.62	76.99	397.61
33B	23,772	320	298.25	91.66	389.91
33C	49,319	388	361.62	131.43	493.05
34A	41,809	345	321.55	113.95	435.50
35	32,355	271	252.58	77.25	329.83
36	62,881	499	465.08	244.70	709.78
36B	25,862	285	265.63	73.79	339.42
Total	1,167,850	9,080	8,462.81	3,276.79	11,739.60

Average cost of ballasting 100 square feet, $0.28 +. Total average cost of 100 square feet of ballast in place, $1.01 —.

Detailed statement of bracing dikes.

Number of dike.	Extent of work.	Quantities of material.					Cost.		
		Round bolts.	Washers.	8 by ⅜ inch spikes.	⅝-inch square iron.	Pine lumber.	Material.	Labor and subsistence.	Total.
	Lin. ft.	*No.*	*No.*	*Lbs.*	*Lbs.*	*Ft., B. M.*			
3	188	114	229	34	.....	3,515	$87.85	$70.67	$158.52
19B	3,171	2,473	4,946	343	282	63,813	1,622.74	646.18	2,268.92
21A	505	322	644	70	108	10,429	260.85	101.92	362.77
22	180	114	229	18	76	3,627	91.46	38.38	130.84
23	385	472	973	106	30	12,349	314.11	145.60	459.71
25	673	450	900	80	153	14,437	361.09	112.20	473.29
26	1,085	741	1,542	110	150	22,872	572.07	207.04	779.11
27	1,416	911	1,872	170	.....	26,523	664.65	169.07	833.72
28	587	548	1,162	60	.....	14,531	366.97	115.92	482.89
29	505	349	718	65	.....	9,500	239.79	92.16	311.95
29A	587	375	750	110	200	13,587	338.24	146.25	484.49
29B	295	217	434	30	.....	5,867	147.91	50.11	198.02
30	3,726	3,638	7,124	585	.....	94,878	2,403.20	918.90	3,322.10
31	506	428	856	60	.....	11,451	289.05	84.72	373.77
33B	573	360	720	85	.....	11,181	278.71	96.63	375.34
33C	754	536	1,072	80	90	15,604	392.19	124.24	516.43
34A	650	452	910	80	.....	12,229	308.71	137.45	446.16
35	486	449	898	15	.....	11,416	288.72	154.04	442.76
36	987	838	1,676	125	.....	20,011	512.05	180.53	692.58
36B	366	603	1,206	50	.....	12,923	334.37	189.55	523.92
Total	17,625	14,390	28,861	2,276	1,089	390,743	9,875.73	3,761.56	13,637.29

The above 17,625 linear feet includes 2, 3, and 4 row dike, and is equivalent to 17,976 linear feet of 3-row dike.

Average cost of labor for bracing 1 linear foot of 3-row dike, $0.55 —. Total average cost of labor and material for bracing 1 linear foot of 3-row dike, $0.76 —.

Detailed statement of lashing dikes.

Number of dike.	Extent of work.	Quantities of material (⅜-inch wire strand).	Cost.		
			Material.	Labor and subsistence.	Total.
	Linear feet.	*Feet.*			
19B	338	1,900	$15.40	$15.51	$30.91
21A	170	600	4.86	6.00	10.86
22	80	310	2.51	3.00	5.51
25	200	700	5.67	7.00	12.67
26	190	1,000	8.10	10.04	18.14
29A	184	500	4.05	3.18	7.23
33C	198	850	6.89	7.56	14.45
Total	1,360	5,860	47.48	52.29	99.77

Average cost of lashing 1 linear foot of dike, $0.04—. Total average cost of 1 linear foot of dike lashed, $0.07+.

Detailed statement of screening dikes with wire netting.

Number of dike.	Extent of work.	Quantities of materials.						Cost.		
		⅜-inch strand.	4 by ¼ inch spikes.	6d. wire nails.	No. 14 wire.	No. 6 wire.	Wire netting.	Material.	Labor and subsistence.	Total.
	Lin. ft.	*Feet.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Sq. feet.*			
B	682	1,850	10	6	6	.....	9,025	$47.76	$48.31	$96.07
C	651	1,000	10	17	10	.....	11,828	51.24	20.83	72.07
D	1,883	1,850	13	34	26	.....	20,469	89.83	38.00	127.83
Y[1]	139	150	4	4	2	.....	2,378	9.96	4.40	14.36
Y[11]	123	150	3	3	2	.....	1,740	7.63	3.40	11.03
1	1,350	.....	27	18	25	123	17,334	68.51	28.79	97.30
2	359	.....	.....	5	.....	.....	5,742	20.64	25.25	45.89
3	199	.....	.....	4	.....	.....	3,664	13.19	19.31	32.50
17	383	500	2	7	2	.....	7,011	29.36	14.81	44.17
17A	2,008	250	2	3	6	.....	3,676	15.42	15.19	30.61
18	163	200	3	3	2	.....	2,494	10.72	4.40	15.12
18A	390	450	3	5	10	.....	5,272	22.91	16.66	39.57
19	168	200	3	3	2	.....	2,557	10.94	1.47	12.41
19A	1,253	850	6	31	20	.....	19,428	77.64	42.19	119.83
19B	2,404	.....	49	33	26	.....	38,154	138.93	73.65	212.58
20	344	400	6	6	5	.....	5,438	23.07	10.29	33.36
21	500	600	10	8	10	.....	7,516	32.38	10.56	42.94
21A	890	400	6	15	5	.....	16,000	61.03	18.20	79.23
22	1,202	800	15	33	10	.....	18,704	74.71	34.11	108.82
23	386	.....	.....	10	.....	.....	8,400	30.26	16.20	46.46
25	467	.....	.....	12	.....	.....	8,000	28.88	32.02	60.90
26	800	.....	5	10	.....	55	8,800	34.02	19.05	53.07
27	863	.....	.....	20	.....	.....	16,588	59.75	47.60	107.35
28	1,330	1,400	8	5	10	.....	19,734	82.40	52.80	135.20
29	1,100	.....	.....	19	.....	.....	16,000	57.63	22.03	79.66
29A	629	.....	.....	20	.....	.....	11,200	40.50	16.67	57.17
30	2,601	.....	.....	45	.....	137	51,428	190.33	109.45	299.78
31	532	.....	.....	10	.....	.....	11,986	43.07	10.52	53.59
33C	702	.....	.....	10	.....	60	15,312	57.35	29.90	87.25
34A	644	.....	.....	10	.....	20	7,838	29.05	18.06	47.11
36	617	700	.....	10	.....	.....	10,266	42.59	21.81	64.40
Total	23,962	11,750	185	419	179	395	383,982	1,501.70	825.93	2,327.63

Average cost of screening 1 linear foot of dike, $0.03+. Total average cost of 1 linear foot of dike screened, $0.10—.

Résumé of cost of dike construction on Osage Division, First Reach, for fiscal year ending June 30, 1895.

Dike B	$96.07	Dike 29 A	$3,042.85
Dike C	72.07	Dike 29 B	1,640.54
Dike D	127.83	Dike 30	22,030.38
Dike Y I	14.36	Dike 31	2,645.09
Dike Y II	11.03	Dike 33 B	2,613.87
Dike 1	97.30	Dike 33 C	3,703.21
Dike 2	45.89	Dike 34 A	3,328.31
Dike 3	593.91	Dike 35	2,651.78
Dike 17	44.17	Dike 36	5,355.24
Dike 17 A	30.61	Dike 36 B	2,302.10
Dike 18	15.12		
Dike 18 A	39.57	Total net cost	91,334.12
Dike 19	12.41		
Dike 19 A	119.83	Superintendence	3,849.76
Dike 19 B	15,351.26	Office and traveling expenses, telephone hire, etc	3,909.15
Dike 20	33.36	Unclassified miscellaneous expenses	1,140.74
Dike 21	42.94	Current care of plant in service	2,303.40
Dike 21 A	2,365.87	Construction incidental expenses	2,201.00
Dike 22	859.60	Steamboat service	9,401.46
Dike 23	2,610.85	Survey	3,046.05
Dike 25	3,167.20		25,851.56
Dike 26	5,224.22		
Dike 27	6,198.02		
Dike 28	3,587.92		
Dike 29	1,259.34	Total cost of dike constructed	117,185.68

EXHIBIT B.

Statement of cost of dike repairs.

Number of dike.	Quantities of material.										
	Stone.	Brush.	⅜-inch wire strand.	¾-inch wire strand.	⅜-inch clamps.	Native oak piles.	White oak piles.	Cypress piles.	Coal.	Round bolts.	Washers.
	Cu. yds.	*Cords.*	*Feet.*	*Lbs.*	*Lbs.*	*Lin. ft.*	*Lin. ft.*	*Lin. ft.*	*Bush.*	*No.*	*No.*
C	.....	.....	900	150	.....	.....	.....	780	40	169	138
D	.....	.....	900	150	.....	.....	.....	366	20	157	120
1	.....	.....	300	540	9	.....	.....	.....	.....	.....	.....
3	.....	.....	1,300	600	.....	.....	.....	.....	.....	.....	.....
17	.....	.....	1,100	.....	.....	.....	.....	400	30	132	66
19A	258	190½	9,300	180	44	.....	7,086	1,444	270	348	708
22	109	65	1,490	.....	3	217	2,361	463	58	134	285
34	.....	.....	.....	.....	.....	.....	.....	1,862	50	112	224
Total	367	255½	15,290	1,620	56	217	9,447	5,315	468	1,052	1,541

Number of dike.	Quantities of material.						Cost.		
	8 by ⅜ inch spikes.	⅝-inch square iron.	6d. wire nails.	No. 10 wire.	Wire netting.	Pine lumber.	Material.	Labor and subsistence.	Total.
	Lbs.	*Lbs.*	*Lbs.*	*Lbs.*	*Sq. feet.*	*Ft., B. M.*			
C	100	310	.....	.....	.....	2,768	$210.69	$142.87	$353.56
D	35	285	.....	.....	.....	936	105.59	110.28	215.87
1	5	.....	.....	5	1,276	.....	29.22	9.32	38.55
3	2	.....	.....	5	2,638	.....	44.18	10.00	54.18
17	70	334	.....	.....	.....	2,944	152.30	125.64	277.94
19A	169	605	20	90	8,000	22,043	2,502.87	1,070.00	3,572.87
22	22	96	.....	14	.....	4,741	835.88	178.36	1,014.24
34	.....	.....	.....	.....	.....	2,539	193.24	133.33	326.57
Total	403	1,630	20	114	11,914	35,971	4,073.97	1,779.81	5,853.78

Net cost of dike repairs		$5,853.78
Superintendence	$246.77	
Office and traveling expenses, telephone hire, etc	250 59	
Unclassified miscellaneous expenses	73.10	
Current care of plant in service	147.61	
Construction incidental expenses	141.00	
Steamboat service	602.55	
Surveys	195.26	
		1,656.88
Total		7,510.66

EXHIBIT C.

Class of material.	On hand June 30, 1894.	Procured during fiscal year ending June 30, 1895.	Expended during fiscal year ending June 30, 1895.	On hand June 30, 1895.	Cost per unit.
Brush ..... cords..	.....	8,746.5	7,816.5	30	$1.61722
Stone ..... cubic yards..	298.3	14,896	14,066.3	1,128	.93203
⅜-inch wire strand ..... feet..	.....	474,000	229,695	244,305	.0081013
White oak piles ..... linear feet..	31,657	81,370	53,850	59,177	.170446
Native oak piles ..... do....	18,473	2,843	16,190	5,126	.10659
Cypress piles ..... do....	217,548	.....	190,664	26,884	.141893
8 by ⅜-inch spikes ..... pounds..	11,706	.....	2,795	8,911	.02327
⅝-inch square iron ..... do....	.....	6,087	2,879	3,208	.01927
No. 10 wire ..... do....	2,712	.....	2,712	.....	.0309
No. 12 wire ..... do....	.....	30,012	23,336	6,676	.019
No. 14 wire ..... do....	.....	20,026	16,455	3,571	.022
No. 16 wire ..... do....	7,176	16,015	11,182	12,009	.020687
Wire netting ..... 100 square feet..	.....	5,120.5	4,026.1	1,094.4	.35733
Yellow pine lumber ..... feet, B. M..	341,133	229,396	443,378	127,151	.002245
Round bolts ..... number..	5,720	13,893	15,940	3,673	.06605
Plate washers ..... do....	9,157	26,000	30,891	4,266	.0027

EXHIBIT D.

The quantities of the principal materials used for construction and repair of plant are as follows, viz:

White pine lumber ..... feet, B. M..	16,123	Tacks, assorted ..... pounds..	.185
Yellow pine lumber ..... do....	198,986	Linseed oil ..... gallons..	592
White oak lumber ..... do....	26,614	Turpentine ..... do....	143
Nails, assorted ..... pounds..	9,050	Green stain ..... do....	94
Spikes, assorted ..... do....	10,384	Canvas ..... yards..	1,097
Metallic paint ..... do....	3,890	Carriage bolts, assorted sizes ... number..	4,108
Red lead ..... do....	606	Unions ..... do....	141
White lead ..... do....	2,950	Elbows ..... do....	312
Oakum ..... do....	20,824	Tees ..... do....	104
Iron, assorted ..... do....	25,607	Caps ..... do....	20
Steel, assorted ..... do....	1,475	Bushings ..... do....	101
Common yellow grease ..... do....	10,798	Reducers ..... do....	41
Castings ..... do....	3,392	Turn-buckles ..... do....	97
Putty ..... do....	275	Pipe ..... feet..	3,553
Spun cotton ..... do....	103		

EXHIBIT E.

Statement of expenditures on account of plant.

Application.	Labor and subsistence.	Material.	Total for each item.	Total.
Plant construction:				
Water supply tank, mains, etc	$543.04	$221.00	$764.04	
Miscellaneous	668.05	384.40	1,052.45	
Constructing 7 skiffs	344.75	60.79	405.54	
Constructing 5 bracing pontoons	326.47	146.77	473.24	
Constructing 5 mattress pontoons	251.34	75.04	326.38	
Constructing 3 sets of steam-hammer leads	777.92	239.15	1,017.07	
Erecting skid ways and steam machinery on barge 59 for unloading piling from barges	276.85	124.14	400.99	
Extending telephone line	348.13	234.40	582.53	
Completing steamer Atalanta	1,666.37	416.14	2,082.51	
Alterations to pile sinkers Nos. 4 and 8 to adapt them for carrying steam hammers, and calking.	1,273.77	311.09	1,584.86	
				$8,689.61
Repairs to plant:				
Alterations and repairs to steamer Doris	1,809.45	409.45	2,218.90	
Alterations and repairs to steamer Melusina	1,519.75	343.62	1,863.37	
Repairs to engine of steamer Thetis	420.16	28.41	448.57	
Sheathing, calking, and repairing graders Nos. 5 and 8, carrying steam hammers	2,162.02	507.22	2,669.24	
Repairs to barges 14 and 24, with quarters	429.85	276.53	706.38	
Repairing and calking 20 64-foot barges	1,213.01	492.92	1,705.93	
Repairing and calking 46 100-foot barges	11,713.69	4,377.88	16,091.57	
Repairing and widening launching ways and repairing and extending storage tracks	2,024.47	1,858.39	3,882.86	
Current repairs to plant	5,724.63	1,355.70	7,080.33	
Repairing and launching barge 8, with quarters ..	122.51	.....	122.51	
				36,789.66

EXHIBIT E—Continued.

Statement of expenditures on account of plant—Continued.

Application.	Labor and subsistence.	Material.	Total for each item.	Total.
Care of plant:				
Pulling out fleet, winter of 1894	$1,846.12	$118.06	$1,964.18	
Launching fleet, spring of 1895	3,314.08	338.34	3,652.42	
General care of plant	12,893.16	669.58	13,562.74	
Coal oil, soap, matches, gasoline, and other supplies			833.61	
				$20,012.95
New plant purchased:				
Stoves, ranges, brooms, brushes, lamps, crockery, furniture for quarters, mess, and other utensils			543.03	
Bolt-cutting machine, anchors, mandril, scales, oars, siphons, drills, dies, expanders, axes, pliers, saws, hammers, augers, and other tools			621.15	
Two Vulcan steam hammers, with hoisting engines complete			2,280.00	
Water tank for machine boat			44.74	
Wire hoisting rope			825.00	
Steam and water hose			240.65	
Rope			1,613.65	
				6,168.22
Superintendence			2,669.00	
Office and traveling expenses, telephone hire, etc			2,766.35	
Unclassified miscellaneous expenses			807.25	
Steamboat service			1,973.95	
				8,216.55
Total				79,876.99

The value of plant material on hand amounts to $8,270.51.

APPENDIX K.

ANNUAL REPORT OF MR. S. WATERS FOX, DIVISION ENGINEER, GASCONADE DIVISION.

MISSOURI RIVER COMMISSION,
OFFICE OF DIVISION ENGINEER,
Chamois, Mo., June 30, 1895.

COLONEL: I have the honor to submit herewith a report of the operations under my charge on the Gasconade Division of Missouri River for the fiscal year ending June 30, 1895. The following illustrations accompany:

A map (Pl. I) of the river from Isbell Station to Rhineland Landing, showing proposed rectification of shore lines, location and character of works completed, in process of construction, and proposed.

Four plates (Pls. II to V) showing in superimposition cross sections of the river, on permanent range lines, taken before, during, and after dike construction.

Two photographic views (Pls. VI and VII) showing accretions formed by dikes constructed in 1893.

Four photographic views (Pls. VIII to XI) showing revetment construction parties at work, and completed revetments.

Because of the practical depletion of funds there was a period of inactivity from July 1 to September 27, 1894, during which the force was reduced to the essential requirements for the care and preservation of plant and records at the Gasconade boat yard.

September 4, I was notified of the extension of the Gasconade Division to include the Chamois and St. Aubert reaches, and under your direction prepared and submitted, September 6, a project and estimates of cost for the complete improvement of those reaches. This project, which was subsequently approved by the Commission, contemplates an expenditure of $579,200 on works between Isbell Station and Portland, Mo., a very erratic stretch of river lying between the lower works of the Osage Division of First Reach and the upper works of the Gasconade Division.

A project was also prepared and submitted September 6 for the expenditure, during the current fiscal year, of an allotment of $450,000 for continuing the systematic

improvement in First Reach. This latter project, which was approved, provided for the expenditure on the Gasconade Division of $259,977, as follows:

Construction of revetment in St. Aubert Bend, 12,000 linear feet	$83,520
Construction of revetment in Chamois Bend, 13,500 linear feet	93,960
Construction of three dikes in Chamois Bend, 800 linear feet and trails	8,500
Repairs to revetment at Gasconade boat yard	8,000
Repairs to dikes (built in 1893)	150
Degrading Keiths Rock	350
Degrading wreck of *Durfee*	200
All other items, viz, administration, care, repairs, and alteration of plant, construction and purchase of new plant, surveys, and contingencies	65,297
Total proposed expenditure on Gasconade Division during the fiscal year ending June 30, 1895	259,977

The three dikes referred to above are not shown on the accompanying map. Their proposed location was in that part of the bend covered by the bar; their purpose, to cause an accretion to form there that would fair out the present shore line of the main bank to the line of the proposed shore. By your direction these dikes were not constructed. The money which was allotted for them was applied toward making the revetment continuous from E′ to F′. With the exception of that change, and the fact that it was deemed unnecessary to expend any money at all in degrading the wreck of the *Durfee*, and but a portion of that proposed for the repair of the Gasconade revetment, the project was carried out as approved. In addition to the work provided for by the above allotment, the construction of the revetment on St. Aubert Island (see Pl. I, C–D), which was provided for in the approved project of September 6, for the complete improvement in St. Aubert and Chamois reaches, was begun by your direction. Some work, also, was done under other allotments, in the way of caring for and repairing plant, and handling construction materials. For convenience, the work done during the year is narrated below in detail under headings characteristic of the several branches. The cost of the works and a statement of the liabilities incurred during the fiscal year are submitted in the form of an appendix to the report.

The prime factor, as always, in fixing the sequence of work for the year was the date of receipt of advice of authority to begin operations. While special authority to put on a small force of laborers to perform some urgently needed preliminary work was given under date of September 27, 1894, it was not until October 15 that notice of approval of project and authority to begin active operations were received. At that advanced stage of the season the following programme of the year's work was arranged: the immediate repairs and launching of just sufficient floating plant to construct, that fall, about 1 mile of revetment in the upper portion of Chamois Bend, and the projected repairs to the boat-yard revetment; to pull the plant out again on the ways, when that work was done, and during the winter to thoroughly overhaul and repair all the fleet needed to finish the construction, before the June rise of the season following, of all of the revetment in St. Aubert and Chamois bends.

THE CARE, REPAIR, AND ALTERATION OF PLANT.

Until September 27, when a small force of laborers, calkers, and carpenters was employed in some urgent preparatory work, the operations from July 1, 1894, were confined to the care and preservation of plant and records.

Floating plant.—Active measures for the preparation of a fleet for the season's work were taken immediately upon receipt of authority October 15, and before the end of that month, the following pieces had been repaired, calked, launched, and equipped for service: The steamer *Sabrina*, three construction quarter boats, four mattress boats, two hydraulic graders, one pile sinker machine boat, equipped for use as an hydraulic grader, thirteen 100-foot barges, and four 64-foot barges. One of the latter was damaged in pulling it off of a bar, and was again pulled out on the ways.

One 100-foot barge, already in the river, was repaired and calked, making a total of fourteen available 100-foot barges. One old mattress boat which was beyond repair was launched, to be gotten out of the way. The new steamers *Thetis*, *Arethusa*, and *Atalanta*, all at that time in an incomplete stage of construction, were also launched. The No. 2 Vulcan steam pile hammer, with boiler and steam hoist, were placed on two 64-foot barges for use in driving revetment anchorage piling. Sixty-five skiffs were put in the river. Beginning November 13, and continuing until December 30, the floating plant was pulled out and placed on the storage ways as fast as the pieces were thrown out of service in construction work. The following hulls were taken out: The steamers *Sabrina*, *Arethusa*, and *Thetis*, office boats *Margaret* and *De Russey*, three construction quarter boats, two hydraulic graders, one pile sinker machine

boat, four mattress boats, fourteen 100-foot barges, three 64-foot barges, and survey quarter boat No. 8, the latter piece having been turned over to me from Assistant Engineer Winchell by direction of the Secretary of the Commission.

All machinery was overhauled and prepared for laying up. Exposed pieces were housed in; small tools, lines, etc., were gathered in, sorted, cleaned, and stored; the yard was cleaned. The repairs to barges provided for in the estimates submitted with the approved project were begun with a small force December 3; a much larger force was put on January 24, 1895, and the work pushed, in order to have in readiness when wanted the necessary fleet for the spring and summer work. The following pieces were repaired, calked, launched, and equipped for service: The steamers *Alert*, *Arethusa*, *Sabrina*, and *Thetis*, the office boats *Margaret* and *De Russey*, construction quarter boats Nos. 1, 4, and 5, four brush quarter boats, one hospital boat, one survey quarter boat No. 8, hydraulic graders Nos. 1, 2, 6, and 7, and pile sinker machine boats Nos. 2 and 12 (the latter for use as hydraulic graders), eight mattress boats (one of these consisted of two hulls 12 by 24 feet), thirty-eight 100-foot barges, seven 64-foot barges, and one barge 20 by 54 feet; making in all seventy-six hulls. Sixty-six skiffs were also repaired and put on the river. The first piece was launched March 4, the majority of them before the end of that month, and the last hull on May 29. The character and extent of the repairs are shown by the following statement of work done on the different pieces, viz:

Steamer Alert.—New chock forward, three new deck beams, ten new floor beams, twelve new outriggers, eleven pieces new bottom plank, one new chain brace and one repaired, one new tiller, new capstan bed, side timberheads, well strainers, guard plank-sheers, and kevils; repaired and reset stack knees, patched deck, repaired rudders, braced rudderpost, shimmed up engine timbers, took off iron sheathing at head, calked hull all over, patched, painted, and sanded hurricane roof, rebuilt and set wheel, put up chimneys, rebuilt furnace, generally overhauled all her machinery, and put up new stovepipes. The entire boat (hull, cabin, pilot house, wheel, and chimneys) was painted. Later in the season a cracked steam pipe was sent to St. Louis and repaired, and a half ring was taken out of the starboard boiler and a new one put in.

Steamer Sabrina.—All of the old woodwork, except the pilot house, was cleared away and rebuilt on a slightly modified plan; new auxiliary wheel flanges were put on; the wheels taken down, shaped up, and rebuilt; all machinery and fittings thoroughly overhauled and repaired; stack knees, chocks, and kevils were repaired; her hull was thoroughly scraped inside and out, oiled below the water line, and painted above. All of the woodwork was painted three coats.

Office boat Margaret.—Was painted two coats outside and one coat in the drafting room and lower dining room. Screen doors were put on all outside doorways on upper deck. A sideboard was made and set up in the dining room; the railing in forward office was extended; the hull was calked all over.

Office boat De Russey.—Removed all old canvas from roof of skylight and hurricane roof, repaired woodwork, recovered it with canvas, and then painted and sanded it. Put in new pieces of plank-sheer, new stanchions, fenders, kevils, nosing, and facier all around, patched guards, put in new waterway around skylight, and painted all new work, calked hull all over.

Construction quarter boats Nos. 1, 4, and 5.—Took out defective rake planks and put in new ones, patched bottoms, reinforced floor and beams near heating stoves, repaired guards and guard fenders, put three new kevils on each boat, erected some extra bunks in office and oil rooms, repaired chains, patched canvas on roofs and painted and sanded same, built and placed new ice boxes on Nos. 1 and 4, painted all new work, repaired stoves and stovepipes, caulked rakes, sides, and bottoms.

Brush quarter boats.—The cabin of the two double-deck pieces were sheathed with three-eighths inch matched stuff, the old hatches were decked over and new ones cut, the ice boxes and ranges were repaired, the hulls calked, and the entire boats painted. The cabin of quarter boat No. 11 was taken from its hull, which was beyond repair, and placed on 64-foot barge No. 106, the repairs to which are given below. The roof was patched with canvas, painted, and sanded; new bunks to accommodate twenty-one persons were at first erected for use of smallpox patients; subsequently these were changed and added to, for the accommodation of forty people; some minor repairs were made to the cabin. The old cabin, which had been in use on land at the Gasconade River quarry, was removed and placed on 64-foot barge No. 102, for use as a quarantine boat; subsequently it was used by the brush parties. The roof was patched with canvas, painted, and sanded; new bunks for forty persons were put in, and slight repairs made to the cabin; the repairs made to the hull are given below.

Hospital boat.—The cabin of the old quarter boat *Pappoose* was removed from its hull, which was entirely unserviceable, and placed on 64-foot barge No. 21 for use, if needed, as a hospital. The cabin was generally overhauled and repaired, and

painted inside and out; the roof was patched with canvas, painted, and sanded; the repairs to the hull are given below.

Hydraulic graders.—The hull of No. 7 was in such an advanced stage of decay that it was practically rebuilt, only the bottom planking being utilized. Some minor repair work was done on the cabin, roof, and derricks. The pumps and boilers were thoroughly overhauled and put in condition for service. Later in the season, a new steam dome and chimney breeching were put on the boiler, and the chimney which was about to go to pieces from rust was replaced by one from pile sinker No. 7. All new woodwork and the entire cabin were painted. Grader No. 6 was also extensively repaired; the Cram steam hammer, pile leads, and steam hoist were removed; a number of new pieces put in the gunwales, floor beams reenforced, new pieces of grub strakes put in, new head blocks, ten new rake planks, twenty new deck beams, new gunwale plank-sheers, new nosing all around, eight new timberheads, new stanchion, new capstan bed, new deck fore and aft and outside of cabin, new hatch coamings, new bracing put under pump and boiler, the pump well repaired; the old derrick masts were taken down and new ones of lighter design erected. Some minor repairs were put on the eabin, the roof patched and painted, the entire hull calked, and, together with the cabin, painted. The large Knowles pump (a duplex, compound condensing, 12 and $22\frac{1}{16}$ by $15\frac{3}{4}$ by 10 inches), which had been taken off of this boat in 1893, when it was used as a pile sinker, was replaced, thoroughly overhauled, and connected ready for service. Some time after this piece was put in service, a crack appeared in the fire box of the boiler. It was repaired; but later two other cracks developed, and it was thought best to lay up the grader until the boiler could be thoroughly inspected.

Graders Nos. 1 and 2.—These pieces required but slight repairs; some sapwood was cut out of the gunwales, the hulls were calked, the roofs patched, and the entire boats painted. The pumps, which had been removed to make room for the steam hoist when these graders were used as pile sinkers in 1893, were replaced, connected with the boilers, and put in serviceable condition. The ash pans and furnaces of boilers were rebuilt.

Pile-sinker machine boats Nos. 2 and 12.—Besides calking the hulls, the only work done on these pieces was the exchange of the Davidson pump on No. 2 for the Smith & Vaile pump from pile sinker No. 7.

Mattress boats.—Of the eight mattress boats repaired two were old ones, Nos. 2 and 6, five new ones, 25 by 70 feet, and one composed of two hulls, 12 by 24 feet. Very slight repairs were made to Nos. 2 and 6; some badly decayed timbers were renewed and the hulls calked. The 25 by 70 foot boats were provided with outrigged platforms and launching ways, extending 13 feet at each end beyond the head block; they were calked and painted. One of the hulls of the small mattress boat was provided with launching ways, the other with a brush platform, fair-leader stanchions, and reel stands; both hulls were calked.

One hundred-foot barges.—Fourteen of these were comparatively new hulls and required but light repairs; the rake seams were shimmed and together with the sides and bottoms were calked. In thirteen others all rotten wood was removed and the repair made thorough, as follows: New rake and bottom planks were necessary, new gunwale pieces; the floor beams were replaced by new ones or, when the old ones where but slightly decayed, repaired; new deck beams, stanchions and beam clamps were put in; a majority of timberheads and kevils were put in new; the others were repaired; new hatch coamings, covers and pump scuttles were made; sapwood was cut out of the sides of five of the barges and out of the bottoms of three of them, and graving pieces set in. New head blocks were put in seven barges, new decks laid on eight of them, decks were patched on three, and patched and sheathed on two; the sides of three barges were sheathed with 2 by 8 inch fir; the plank-sheer and grub strakes were renewed; all hulls were calked, sides, bottoms, and rakes, and all new or patched decks were calked. Cross chains of inch square iron with turn-buckles were put in twenty-four of the hulls; in eleven of them two chains were put in each hull, in the others four chains; all hulls were painted. Eleven other barges were temporarily repaired, with a view to service this season only, as follows: One was given an entire new deck; the decks of three were patched and sheathed, and those of the other seven patched; all were calked (sides, rakes, and bottoms) as well as all decks not sheathed.

Sixty-four-foot barges.—Seven of these hulls were comparatively new, and needed but slight repairs, as follows: Rake seams were shimmed, and, together with sides and bottoms, were calked. Three old hulls were thoroughly repaired, as follows: One was given an entire new deck, the decks of the other two were patched; new hatch coamings and covers were made; new head blocks were put on two hulls, and new bottom plank on one; plank-sheers were renewed, and new gunwale strakes put in where needed; many of the floor beams were repaired by spiking on new ends; sapwood was cut out and refilled with new wood; the new decking, sides, rakes, and bottoms were calked. All new work was painted. Each of the barges was equipped

with its full complement of hatch covers, capstan bars, bilge pumps (four to 100-foot barges and two to 64-foot barges), and lines. This necessitated extensive repairs to seventy-six old pumps and the construction of thirty-eight new ones; the latter are mentioned again under new plant.

Skiffs.—These repairs consisted in putting in new rowlocks, seats, and ribs where needed, calking, painting, and numbering.

The cost of launching, pulling out, making the above repairs, and some other current and miscellaneous repair work of minor importance, is shown in the appendix, Exhibit A.

Yard plant.—With a view to economy of time and expense, the yard engines used in pulling boats on the ways were overhauled and rearranged, for single-line, pulling with 1-inch steel cable instead of multi-line pulling with manila rope as heretofore. The east yard engines were coupled together so as to work on a single shaft, instead of independently as before; they were mounted on a new frame, which was set at the east end of the shunting track, and anchored securely. New gears to secure the desired speed, and new bed plates and whelks for the two double-barrel capstans were provided, also chocks and rollers for leading the cable to them; a reel was swung behind each of them for entailing the cable. The boiler was set off on the north side of the track and connected up with the engines; a number of new flues were put in the boiler; the yard main was tapped and piped to it for water supply. The west engine and boiler, mounted on its old frame, was set off the shunting track at the west end on mud sills and anchored there. The barrel of the south capstan was reduced in diameter to entail the cable at the same speed as north capstan. Conical rollers mounted on stands and placed about 100 feet apart were made, and used for holding the cable off of the ground while in service. It is estimated that a saving of $1,500 was effected by this method in launching hulls last spring. Ninety-six dead men with 1¼-inch cable fastenings were planted in the yard for use in pulling boats on the ways. The three-drum steam hoist was set and anchored in the yard just west of the storage ways, connected for steam to the mill boiler and housed in, for use in overhauling yard tackle and other light pulling about the yard. The yard ways were leveled up by shims and shored where necessary. Two carriages for shunting hulls on the way track were rebuilt, and provided at each end with heavy iron tongues for attaching the pulling lines to. Ten of the horse capstans were practically rebuilt for use in an emergency in pulling boats on the ways. The river end of the suction pipe for the mill supply was protected by driving four clusters of three piles each in the river; the pipe was boxed in and swung from a platform supported by the piles.

A shed extension, 11 by 17 feet, was built on the north end of the blacksmith shop to afford room for another fire; the three forges were connected by galvanized-iron blast pipe and fittings to the fan in the mill. Two rooms were partitioned off and floored in the storage shed to the south of the quarters, one for storing pipe fittings, the other for invoicing and sorting property. Two pits, 8 by 10 by 10 feet deep, were dug for cesspools, to the south of the quarters.

The old ice house (13 feet square and 20 feet high) was removed from the southeast part of the yard and set on the south side of the Government spur track near the mill; a new bottom was put in it, and, for a time, it was used simply for the storage of ice; in April it was altered for use as a cold-storage room for meats. Its roof was newly canvassed and the entire house painted. A large ice box at the quarters was rearranged in the same way. An old ice box (6 by 10 by 8 feet high) that had been in disuse for several years was repaired, for use in carrying ice and meats to the brush parties; it was newly ceiled inside and out and set on a frame with dollies, so as to be readily moved from one barge to another.

The floor of the kitchen at the quarters was covered with 1½ by 6 inch decking and calked to protect the office room below from damage by scrubbing water leaking through.

The steam saw and planing mill was kept in operation continuously from October 1 to date, and no repairs of moment were necessary. The shafting was lined up, the steam engine was anchored more securely, and the house painted outside.

A large number of wheelbarrows and purchase blocks were extensively repaired. Small tools of all kinds were repaired.

The cost of the work under heading of "Yard plant" is shown in the appendix, Exhibit A.

The following work was done by direction of the secretary of the Commission: A barge 20 by 54 feet was given slight repairs, calked and launched, and equipped with a steam pile-driving apparatus for use in revetment construction in the vicinity of Pryors Mill, on the Gasconade River. The cost of the work ($98.12) was charged to the appropriation for improving the Gasconade River. By direction of the secretary, survey quarter boat No. 8 was provided with an ice box, the roof covered with new canvas and given three coats of paint and sand; the cabin painted inside and out, the hull calked, and some minor repairs made. The cost of this work ($151.60)

was charged to the allotment for surveys, gauges, physical data, and publications. There was also an expense of $16.85 incurred, by direction of the secretary, in transferring property pertaining to the improvement of the Gasconade River to the boat yard at Gasconade. This item was charged to the appropriation for improving the Gasconade River.

NEW PLANT.

The construction of the new steamers *Atalanta*, *Arethusa*, and *Thetis*, begun during the previous fiscal year, was finished. The first two were referred to in last year's report as the stern-wheel tenders. The *Atalanta* was practically finished and turned over to Division Engineer Samuel H. Yonge on November 9, 1894. The *Arethusa* was finished and outfitted, and after a satisfactory trial trip November 21 was put in commission. The work done on them may be briefly stated as follows: The stern-wheels were built, the pitmans gotten out, and iron stack knees built, of channels, angles, and plates; rudders were hung, tillers put on and connected to pilot wheels; kevils, jack staff, coal bunkers, side curtains of canvas, and a sheet-iron bulkhead for protection of boiler were put in; side hand capstans were set, boiler feed-water pumps and steam capstans were placed, piped, and fitted; the engines lined, cleaned, and coupled up. The exposed parts of the boiler on the *Arethusa* and its fittings were covered with asbestus cement; all steam piping and fittings were covered with magnesia steam covering. Her performance while in service during the winter of 1894 indicated the advisability of the following changes, which were made, viz: A new set of five-eighths-inch cut-off cams were put on; the cam rods were made heavier; the reversing gear was changed to a more convenient position; blow-off valves at the mud drums of regular steamboat pattern were substituted for those of the ordinary pattern at first furnished; the valve levers and lifters were ridered for more favorable action, as suggested by steam-indicator cards; a blower was put on, and several adjustments made in the orifices of the blast nozzles; three knuckle chains were put in the hull under the engine room. She has been in constant service on this division since the 8th of March and has proven to be an invaluable addition to the fleet.

Besides the building of bunks, lockers, ice box, closet, and stairways forward and aft, the work of completing the construction of the steamer *Thetis* was confined to placing piping and fitting up her boiler, steam capstan, feed-water pump, engines, and wheels. The exposed parts of the boiler and its fittings were covered with asbestus cement; all other steam fittings and pipings were covered with magnesia steam coverings. She was finished and outfitted, and after a trial trip March 17 was put in commission. It soon developed, however, that her engine timbers were too light. She was pulled out on the ways, her engines taken down, heavier engine timbers (9 by 15 inches) and twelve additional floor timbers put in, and, after setting up the engines, again launched, on the 22d of April. These changes afforded the desired rigidity of floor, but the pedestals proved to be too light. Fore and aft chains from the pedestals to the engine timbers remedied the trouble to some extent, but it is thought that new pedastals, of somewhat different design and much heavier, will have to be substituted for those now on her before anything like the full power of the engines can be used with safety.

Three skiffs were built during the fiscal year; one of them, 26 feet long, for the towboat *Alert;* another, 22 feet long, for use of survey party, and the third, a clinker-built skiff 14 feet long, for the *Thetis*.

Thirty-eight new bilge pumps were made for use on barges. Twenty-four folding chairs, of oak, with canvas bottoms, were made for the steamers.

A single-track railway of 21½-inch gauge, supported on piles, was built in the yard west of the mill and equipped for use in transferring coal from cars on the spur track of the Missouri Pacific Railway to floating plant. The car has a capacity of 1 ton of coal. It dumps automatically on both sides at once and at any desired point. It is moved back and forth over the track by means of a cable operated by a steam winch at the loading end of the track. The length of the track is 310 feet. At the river end the coal is dumped into a chute, the upper part of which is fixed, and brings the coal to a central discharge into a swinging iron chute, whence it may be delivered in rows on barges or into the coal bunkers of steamors or other floating plant at various stages of the river. Thirty piles, in clusters of three, were driven in the river on a line parallel with the shore, to act as fenders for the hulls while being loaded. It has been in successful operation now for two months and has about paid for itself in the saving effected in the cost of handling coal. The construction of a two-wired telephone line from the boat yard at Gasconade to Chamois, 13.37 miles, was begun October 18. It was finished and put in operation November 14. Subsequently it was extended to the field office at the head of Chamois Bend, about 2 miles farther. The cost of the new plant described above is shown in the appendix, Exhibit B.

REVETMENT REPAIRS.

Gasconade boat yard.—The boat-yard revetment was constructed in the summer of 1893 during a high stage of river. For a distance of about 1,200 feet from its head downstream the mattress was laid on a bench, submerged at that time from 2 to 4 feet. This bench in some places was nearly the width of the mattress, so that when the river fell below S. L. W. the outer edge of it was exposed in places; and, as it was thought desirable to hold the shore line out there, it was proposed to widen the revetment by the construction of a mattress, joined onto the old one and extending 40 feet beyond S. L. W.

Work was begun with a small party November 1. After consultation with you three days later it was decided to be unnecessary to construct all of the work that fall, and but 521 linear feet of mattress was woven, extending from a point 130 feet above the old revetment. The work was finished November 27. The materials used were procured by hired labor; the rock ballast (1,110 cubic yards) was quarried from Keiths Rock, reducing the average height of the latter to about that of S. L. W.

For a week, ending November 4, the quarry force operated in the old Gasconade River quarry and produced about 300 cubic yards of ballast; but that river fell to such a stage that the quarry could not be reached by boats. The ballast is still there. The cost of this work is shown in the appendix, Exhibit C.

DIKE REPAIRS.

At the time when the project was being prepared (the fall of 1894) an inspection of the dikes constructed in 1893 showed them to be in need of no repairs, except that the curtain poles were broken or missing in places. The estimates provided only for that work in an item of $150. When the repairs were undertaken, in the following spring, after the dike had been again exposed to the action of ice, it was found that a few piles and braces were broken or missing. A small party was engaged in that work from March 14 to 28. One thousand four hundred and thirty-eight curtain poles were expended in patching the curtains on Dikes II, IV, VII, VIII, IX, X, XI, and XII. Two piles were driven at the outer end on the upper corner of each of Dikes VII, IX, and XI, to reenforce them; three other piles were driven in Dike IX to replace those broken. A number of broken and missing wales and braces were replaced and some extra lashings of three-eighths-inch strand used where it seemed advisable. This work put all of the dike in excellent condition. The expense involved is shown in the appendix, Exhibit D.

REVETMENT CONSTRUCTION.

Chamois Bend (*see Pl. I, E′–F′*).—A bar growth some 4,000 feet in length, and separated from the main bank at low water by a narrow, shallow thread of water, divides Chamois Bend into three sections, which are referred to below as the upper, middle or bar section, and lower section.

There was time only in the fall for the revetment of the upper section. This work was begun October 17, 1894, and finished January 30, 1895. The head of the revetment rests at the point E′, and extended downstream 5,055 feet to point E″. The point E, originally intended for the head of the work, was masked by a shoal bar, making it inaccessible to floating plant. It is thought that the works now in progress of construction in the reach above will insure the revetment against loss by flanking. Hydraulic graders Nos. 1 and 2 and pile-sinker machine boat No. 12, the latter equipped as a grader, were in service as follows: No. 1 for forty days, No. 2 for forty-one days, and No. 12 for fifteen days; 5,055 linear feet of bank, containing 58,221 cubic yards of earth, was graded to an average slope of 3 on 1.

Mattress weaving was begun October 22 with two parties. A third party was put in service one week later. Their work was finished November 14, 16, and 17, respectively, having woven in all 5,155 linear feet, or 489,636 square feet, of mattress, including two laps. The driving of anchorage piling was begun October 29 and finished November 19. Four hundred and eighty-two white oak piles were driven 10 feet apart along the water's edge to an average penetration of 19.73 feet. The distribution of rock ballast on the mattress and bank was begun October 22 and finished January 29; 18,437 cubic yards of rock was thus expended, an average of 3,647 cubic yards per linear foot of bank protected. Of this amount 1.428 cubic yards per linear foot was put on the work below S. L. W. and 2.219 cubic yards above.

When revetment construction was resumed in the spring the stage of river was so low that the middle of bar section was inaccessible to floating plant. The start, therefore, was made at the head of the lower section, just under the bar. The revetment of this section from point F′ (Pl. I) upstream, 5,210 linear feet, was accomplished between March 17 and May 28.

Bank grading was begun March 16 with hydraulic grader No. 1 and was finished April 20. Graders Nos. 2, 7, 12, and 6 were put in service March 20, 22, 25, and 27, respectively; 5,210 linear feet of bank, containing 81,840 cubic yards of earth, was graded to an average slope of 3 on 1. The bed of Greasy Creek at a point 2,000 feet (measured along the revetment) above the mouth was so close to the shore line of the river that a new mouth for it was made there by grading through the intervening bank and throwing a levee across the old bed on the lower side. This levee was built to an elevation 2½ feet above S. H. W. and revetted.

Mattress weaving was begun March 19, with one party, and finished April 24. The second, third, fourth, and fifth parties were put in service on the 25th, 26th, 27th, and 30th, respectively, of the same month. Five thousand four hundred and thirty-two linear feet, or 606,827 square feet, of mattress was woven, including four laps. The distribution of rock ballast on the mattress and bank was begun March 27 and finished May 28. During the April rise, which occurred while work in the lower section was in progress, an effort was made to revet the bar section; but the rise was so small and of such short duration that the floating plant had to be withdrawn on April 22 before either the grading or mattress work had been finished. On June 10, the river having attained a stage that afforded the necessary depth of water in the chute, operations in the bar section were resumed with two mattress parties. A third party began work on June 12. Two hydraulic graders were put in service there on June 12 and a third grader on June 20. The former work was finished on June 15, the latter on June 25. The total length of bank graded in the bar section was 4,365 feet, containing 22,733 cubic yards of earth. Four thousand five hundred and six linear feet, or 453,761 square feet, of mattress, including seven laps, was woven. The revetment from E′ to F′, a distance of 14,630 feet, is now continuous, and is completed, except in that portion described as the bar section, from E″ down 4,365 feet, which requires the distribution of 8,000 cubic yards of rock on the mattress and bank, at an estimated cost of $10,500. The stage of river permitting, this work will be completed by July 20.

The cost of the Chamois Bend revetment to date is shown on the appendix, Exhibit E.

St. Aubert Bend (*see Pl. I. A′-B′*).—The revetment of this bend was begun April 22 at the point A′ instead of at A, as originally projected, because of the shore bar which covers the latter. It was carried downstream 11,500 feet to the point B′ and stopped there to allow the bank to cut back to the line of the proposed shore. The work is still in progress, requiring the distribution of 7,250 cubic yards of ballast on the upper bank to complete it.

Bank grading was begun April 22, with three hydraulic graders, and finished June 8. Two other graders, making five in all, were in service for the greater portion of the time. Four thousand five hundred linear feet of bank was graded to an average slope of 2½ on 1; 5,700 linear feet to an average slope of 3 on 1; and 1,200 linear feet was graded flat, to the water's surface. The latter was done in removing the narrow strip of land that separated the Missouri River from Middle River, for a distance of 1,120 feet above the mouth of the latter. In this way the mouth of Middle River was carried upstream that distance. The total quantity of earth removed by jet in St. Aubert Bend was 139,745 cubic yards.

Weaving mattress was begun with one party April 23 and finished June 9. The second, third, and fourth parties began weaving April 24, 25, and May 4, respectively. A fifth party, equipped with the small mattress boat, was in service from May 17 to June 9, weaving mattress from a point on the left bank of Middle River, 100 feet above its new mouth, down to the old mouth; and in extending the mattress around the point of the south bank of Middle River at its mouth. In all, 12,244 linear feet, or 1,379,334 square feet, of mattress, including six laps, was woven. The distribution of rock ballast on mattress and bank was begun April 30 and continued to date; 27,584 cubic yards have been thus expended, completing 7,900 linear feet of revetment; the balance of the bank has been ballasted to various heights, being kept above the water surface all along. It will average about 8 feet above S. L. W., and, as previously stated, will require the distribution of an estimated amount of 7,250 cubic yards of ballast at an estimated cost of $10,000 to complete it. This will be accomplished by August 5.

A bill of cost of this work to date is shown in the appendix, Exhibit F.

St. Aubert Island (*see Pl. I, C-D*).—As has been stated, this work, although approved by the Commission, was not provided for by the allotment current at the time at which it was begun. It was provided for, however, in the allotment of $610,000 now current for systematic improvement in first reach. In accordance with your instructions, given on May 23, work was begun four days later and is still in progress. The bank for the entire distance covered by the proposed revetment was so covered with undergrowth and drift that it was necessary to clear it up before the hydraulic graders could be put to work. A force of twenty-three men was occupied in this way from May 27 to June 7. Bank grading was begun with one

grader May 31 and finished June 27; four other graders were put in service as follows: June 1, 3, 4, and 8; 5,028 linear feet of bank, containing 33,796 cubic yards of earth, was graded to an average slope of 3 on 1.

Weaving mattress was begun with one party June 10; a second party began work June 17. Both parties are now in service, having woven to date 2,930 linear feet, or 315,280 square feet, of mattress. The distribution of rock ballast up to this date has been confined to sinking the mattress; 834 cubic yards have been thus expended. The total cost of this work to date is $9,100.60.

The specifications which govern the construction of the revetments above reported differed from those used on previous works in the following details, viz: Anchorage piles were used only in the upper section of Chamois Bend; the use of 1¼-inch second-hand car cable in the outside selvage and for transversals was abandoned; double (two parts) three-eighths-inch galvanized-steel strand for longitudinals and transversals were used, the former spaced 15 feet apart in pairs, beginning 5 feet in from the outer selvage of the mat, the latter spaced 10 feet apart in pairs and extending from the outer longitudinal to stone deadmen on the bank. One of the strands of each pair of longitudinals and transversals was kept underneath the mattress and the other on top; they were brought together and lock twisted at every intersection of longitudinals with transversals; the bank grading was done, either partially or completely, in advance of the mattress; the shore edge of the latter rested well up on the slope beyond the fore shore formed by the talus from grading; the bank above the water surface was first paved with rock weighing from 20 to 100 pounds each, beginning at the top of the grade, at an elevation 2½ feet above S.H.W. and working down, with the rock on edge usually, to give a thickness of about 10 inches. This paving was then covered with fine spawls of rock, to a depth of 3 to 6 inches.

In the St. Aubert Bend work, the bank mat was first covered with fine rock spawls to fill the interstices or meshes formed in weaving. Near the head of this work, for a length of about 1,200 feet, no paving rock was used on the upper bank; it was covered with spawls to a depth of 10 to 14 inches.

PROCURING CONSTRUCTION MATERIAL.

The brush and rock used in the above works were procured by hired labor. Three brush parties were organized and put in the field on October 17, 18, and 23, respectively. They were in service until November 13, when, having procured 3,414.5 cords of brush, the quantity needed for the fall work, they were disbanded.

On February 9 a small party was organized and put in the field for the purpose of getting brush out to steamboat landings in advance of the opening of navigation so that no delay for want of brush would occur when active operations were resumed. They were given a quarter boat March 11. A loading party was sent out March 9 to load the brush then ready, and another party was put in the field prepared to cut, bind, haul, and barge brush. One of these parties is still in service; the other was laid off May 24.

The total quantity of brush cut and bound to date is 19,248.9 cords. Of this quantity 19,068.9 cords were barged and 18,146.2 cords delivered on barges on the works at points of expenditure. A very small portion of it was procured in the immediate vicinity of the works, but the major portion came from points down the river—some of it from Gumbo, Mo., which is about 90 miles below the upper works.

A quarry site was selected in the bluff immediately south of the head of the Chamois revetment and arrangements made with the owner for quarry privilege and road right of way, the consideration being the payment by the Government of 1 cent per cubic yard of rock ballast removed. Operations began October 23 and have been continued to date, with only such interruptions as were incident to inclement weather. The total product of the quarry to June 30 is 67,882 cubic yards of rock ballast; the average output per working day was 326.04 cubic yards. During the winter, while expenditures of rock were very small or entirely suspended, the rock was hauled to the river bank and stored, and by the time navigation opened in the spring 19,435 cubic yards had been thus accumulated. Had it not been for this source of supply the amount of revetment constructed would have been greatly curtailed, as the quarry could not possibly have supplied sufficient ballast to keep pace with the mattress work. The haul from the quarry to the river bank is 3,800 feet; the average haul of the stored rock is 5,800 feet.

TOWBOAT SERVICE.

The following steamers were in service during the fiscal year handling plant, construction materials, supplies, etc.: The U. S. steamer *Alert*, from March 22, 1895, to date—her work was confined very largely to towing barges loaded with brush from the brush patches to the works; the U. S. steamer *Arethusa* was in service from November 21 to December 30, 1894, and from March 8, 1895, to date; the U. S. steamer

Sabrina from October 16 to November 23, 1894, and from March 31, 1895, to date; the U. S. steamer *Thetis* from March 17 to March 31, and from April 25 to date; the steamer *Gasconade*, owned by the Hermann Ferry and Packet Company, was hired on October 17, and was in service until November 20, 1894.

By your direction the following bill of dike materials was loaded on barges at the Gasconade yard for transportation to the Osage division for use there:

Lumber and piling:		
White oak piling, 30 feet to 55 feet long	pieces	1,966
Pine lumber, 4 by 8 inches by 22 feet	do	1,215
Pine lumber, 6 by 8 inches by 12 feet	do	100
Bolts and washers:		
Screw bolts, $\frac{3}{4}$ by 21 inches	pounds	5,000
Screw bolts, $\frac{7}{8}$ by 19 inches	do	3,000
Drift bolts, $\frac{5}{8}$ by 15 inches	do	4,000
Plate washers, $\frac{13}{16}$ inch	do	400

The expense involved in this work, $902.96, was charged to the allotment for systematic improvement in first reach.

SURVEY WORK.

A shore-line survey of the river from the mouth of the Auxvasse River to the foot of Chamois Bend, a distance of 24,000 feet, was made September 20 to 29 in order to determine changes which had occurred since October, 1893, the date of the survey upon which the approved project had been based. When active operations were in progress the survey work was performed by a party organized as follows: A chief of party, who performed the instrumental work in the field and platted the notes in the office; four men, at a salary of $35 per month each, as skiffmen, rodsmen, and axmen, and who reported to some of the foremen of construction parties when not on survey duty; and occasionally, when taking soundings, two extra men were detailed from the laborers on one of the construction parties. Between November 1 and December 6 a hydrographic survey from the head of Chamois Reach to Little Tavern Creek was made. Nine tertiary triangulation stations based on secondary line Chamois-Portland and connecting with the triangulation of 1893 were located and occupied. Dependent upon this triangulation a stadia survey was made, covering 26½ miles of shore line and 23 miles of bar line. Permanent ranges Nos. 233 to 272, inclusive, on the reach from St. Aubert Island to Little Tavern Creek, were located; ranges 178 to 185 and 214 to 272, inclusive, were sounded. During the month of May thirteen tertiary triangulation stations based on the secondary line Chamois-St. Aubert and extending from Chamois Bend to the head of St. Aubert Bend were located and occupied.

May 20, 21, the ranges 232 to 214, inclusive, and range 185 were resounded. Just in advance of the construction parties the survey party staked off the work in 100-foot sections, established the elevation of each stake with reference to St. Louis City Directrix, and sounded partial sections of the river on lines normal to the flow from each of the stakes. After the mattress had been woven and sunk these sections were resounded. In this way the position of the mattress was ascertained, and if it appeared that the mattress was not entirely down at any point directions were given for additional ballast. After the upper bank had been graded the survey party established a grade line at an elevation of 2½ feet above S. H. W. for the upper limit of the bank ballast. All of the dikes proposed for the next fiscal year, 14 in number, were located in the field and their sites marked by signboards. An inclined gauge was established on the Chamois revetment in the lower section and read twice daily. All of the shore lines and hydrographic work described above was platted in the office. The cost of this work was $1,316.46.

MISCELLANEOUS.

One of the marked incidents of the year was the appearance on the work, April 1, of a case of varioloid in the person of Isaiah Boston, a colored cook on one of the construction quarter boats. At the time there were 831 men in service on the division and a general stampede was threatened for several days. The services of a physician were engaged at once, and a second physician was in consultation April 3 and 4. All customary precautionary measures were taken at once to prevent the disease from spreading. The patient and those who had been especially exposed were promptly isolated, the former in a quarter boat on an island, the latter in a quarter boat below the work; all quarters were thoroughly and repeatedly disinfected by fumigation and washings; all employees then on the work and those who were engaged subsequently were vaccinated. The patient died from the disease April 8. No new cases developed on the works. The immediate result of the appearance of the disease

was the loss of 75 men from fear of contagion. A large number left later on for the same reason from a disinclination to submit to vaccination. Besides the loss of men the work suffered in many ways from the limitations and restrictions necessarily placed upon correspondence, movements of plant and parties, etc.

The total number of 292,372 meals were served on the works during the year, at an expense for labor, stores, and supplies of $36,053.67, or an average of 12⅓ cents per meal. During the months of April, May, and June 181,048 meals were served, at an average cost of 11⅔ cents per meal. The greatest number of employees engaged on the work at any one time was 1,009; of this number 218 were not furnished subsistence.

A difference of 40 cents per day, or $15 per month, was made in the rate of wages paid on account of subsistence. Unskilled labor was paid at the rate of $1.10 per day and subsistence, or $1.50 per day without subsistence.

On March 22, as the U. S. towboat *Alert* was going upstream with mattress boats Nos. 2 and 6 in tow the latter, which was on the outside, ran onto a "blind break," which made a large hole in her rake. The hull filled with water very rapidly and all efforts to stop or check it proved useless. It was run over to the bar and grounded, the capstans were taken off, and she was then abandoned by the steamer. On the following morning the wreck was visited and, it being concluded that it would not pay to raise the hull, measures were taken to have it dismantled of such timbers, irons, etc., as the expense of removal would warrant. This work was in progress when a rise in the river covered it.

In accordance with the instructions contained in your letter of April 20 projects and estimates of costs, accompanied by a map, were prepared and submitted under date of May 15 for the complete improvement of the Gasconade division and for the expenditure during the fiscal year ending June 30, 1896, of an allotment of $300,000. By your direction the latter project was revised for an expenditure of $305,000 and submitted June 15. The project provided for the construction during the next fiscal year of the following works (see pl. 1): Dikes 1 A, 3 A, 5 A, 7 A, 9 A, revetment C–D, Dikes 20 A, 22 A, 26 A, 28 A, 14, 22, 24, 26, and 28. The revetment C–D, now in progress of construction, will be pushed to completion as rapidly as possible. The construction of the dikes will be undertaken as soon as the materials can be secured.

Before closing I desire to acknowledge the support afforded me by my assistants as well as the spirit of cooperation and interest manifested in general by the employees of the Gasconade division.

Very respectfully, your obedient servant,

S. WATERS FOX,
Division Engineer.

Lieut. Col. CHAS. R. SUTER,
Corps of Engineers, U. S. A.,
President Missouri River Commission.

EXHIBIT A.

Care, repair, and alteration of plant, 1894 and 1895.

	Labor.	Subsistence.	Supplies.	Materials.	Cost in item.
Care of plant:					
Watching	$8,691.35	$2,913.77	$154.56	.....	$11,759.68
Pulling out (34 hulls)	1,636.00	481.60	79.35	.....	2,196.95
Launching (108 hulls)	3,156.71	994.30	308.40	.....	4,459.41
Cleaning, sorting, and storing	697.40	283.05	9.50	.....	989.95
Total	14,181.46	4,672.72	551.81	.....	19,405.99
Repairs and alteration of plant:					
Floating plant	25,798.23	4,261.33	.....	$12,402.01	42,461.57
Yard plant	3,514.77	691.31	.....	455.40	4,661.48
Current miscellaneous repairs	1,047.73	99.85	.....	55.25	1,202.83
Alterations to plant	206.60	41.18	.....	.....	247.78
Total	30,567.33	5,093.67	.....	12,912.66	48,573.66
Grand total	.....	.....	.....	.....	67,979.65

EXHIBIT B.

New plant.

	Labor.	Subsistence.	Materials.	Supplies.	Cost in item.
Steam tenders Arethusa and Atalanta	$3,484.74	$631.91	$553.90	$34.03	$4,704.58
Steam tender Thetis	2,232.19	389.69	883.09	64.28	3,569.25
Single-track tramway for coal	308.20	48.73	480.38	.....	837.31
Skiff for survey party, 22 feet long	37.25	6.58	23.05	.....	66.88
Skift for towboat Alert, 26 feet long	109.92	18.96	28.13	.....	157.01
Yawl for steam tender Thetis, 14 feet long	77.50	13.67	20.70	.....	111.87
Construction of telephone line	412.12	.....	305.47	.....	717.59
Total	6,661.92	1,109.54	2,294.72	98.31	10,164.49

EXHIBIT C.

Bill of cost of repairs to revetment at Gasconade boat yard, Gasconade, Mo., 1894.

Classification and extent.	Cost in item.
Procuring 319 cords of brush:	
Stumpage	$30.05
Binding wire	2.16
Labor, cutting, binding, hauling, barging	328.94
Subsistence	107.34
Towage to points of expenditure	80.97
Total cost, at $1.72 per cord delivered on work	549.46
Procuring 1,110 cubic yards of rock from Keiths Rock:	
Quarry privilege	14.80
Supplies	26.77
Labor, quarrying, and barging	700.48
Subsistence	239.69
Towage to points of expenditure	15.00
Total cost, at 89 cents per cubic yard delivered on work	996.74
Procuring 270 cubic yards of rock at Gasconade River quarry:	
Supplies	6.51
Labor, quarrying	165.26
Subsistence	47.78
Total cost, at 81 cents per cubic yard in quarry	219.55
Grading bank 521 linear feet, or 2,086 cubic yards of earth:	
Labor	144.98
Subsistence	44.47
Supplies	24.55
Total cost, at 10¼ cents per cubic yard of earth	214.00
Construction of mattress 521 linear feet, or 38,392 square feet:	
Labor, weaving, and anchoring	420.60
Subsistence	162.04
⅜-inch strand, 4,590 pounds	117.96
Total cost, at 1.8 cents per square foot	700.60
Patching old mattress:	
Labor	64.30
Subsistence	22.63
Total cost	86.93
Ballasting mattress and bank (1,110 cubic yards of ballast) 521 linear feet of revetment:	
Labor	235.37
Subsistence	90.75
Total cost, at 29.4 cents per cubic yard	326.12
Grand total	3,093.40

EXHIBIT D.

Bill of cost of repairs to Dikes II, IV, VII, VIII, IX, X, and XI.

Materials and labor.	Cost in item.
Materials:	
9 white oak piling	$48.60
266 feet, B. M., pine wales and braces	4.25
201 pounds ⅜-inch strand	5.17
39 bolts	2.57
31 washers	.10
500 spikes	1.00
Total	61.69
Labor:	
Driving piling, procuring and placing 1,438 curtain poles, placing and lashing new wales and braces	233.75
Total	295.44

EXHIBIT E.

Bill of cost of 14,630 linear feet of incomplete revetment in Chamois Bend, 1894 and 1895.

Classification and extent.	Cost in item.
Procuring 8,718 cords of brush:	
Stumpage	$732.31
Binding wire, 8,718 pounds	181.61
Labor, cutting, binding, and barging	8,647.98
Subsistence	2,445.53
Towage to points of expenditure	2,554.99
Total cost delivered on works, at $1.67 per cord	14,562.42
Procuring 37,461 cubic yards of rock ballast:	
Quarry privilege	374.61
Quarry supplies	1,158.00
Labor, quarrying, hauling, and barging	34,567.37
Subsistence	503.07
Towage to points of expenditure	603.38
Total cost delivered on works, at 99⅓ cents per cubic yard	37,206.43
Grading bank 14,630 linear feet, containing 162,794 cubic yards of earth:	
Labor	2,132.81
Subsistence	574.73
Supplies	655.37
Total cost, at 2 cents per cubic yard	3,362.91
Building levee at Greasy Creek, containing 788 cubic yards of earth:	
Labor	119.39
Subsistence	7.74
Total cost of levee, at 16 cents per cubic yard	127.13
Construction of mattress 15,093 linear feet, or 1,550,224 square feet:	
⅜-inch strand, 189,079 pounds	4,882.17
Piling, white oak, 482 sticks, 25 feet long *	1,192.95
Labor, weaving, and anchoring to bank	10,703.05
Subsistence	3,862.96
Supplies (wood, coal, and oils)	36.36
Total cost, at 1⅓ cents per square foot	20,677.49
Ballasting mattress and bank (incomplete), 37,461 cubic yards placed to June 30, 1895:	
Labor	6,976.21
Subsistence	1,756.53
Total cost of placing, at 23⅓ cents per cubic yard	8,732.74
Towage, moving construction parties, their plant and supplies	2,400.77
Total cost of 14,630 linear feet of revetment to June 30, 1895	87,069.89
Estimated cost for completion, procuring, and placing 8,000 cubic yards of rock ballast	10,500.00

* Anchor piling were used in 5,055 linear feet of this revetment.

EXHIBIT F.

Bill of cost of 11,500 linear feet of incomplete revetment in St. Aubert Bend, 1895.

Classification and extent.	Cost in item.
Procuring 7,262 cords of brush:	
Stumpage	$726.20
Binding wire, 7,262 pounds	206.97
Labor, cutting, binding, and barging	7,286.20
Subsistence	1,882.88
Towage to points of expenditure	5,661.10
Total cost delivered on works, $2.17 per cord	15,763.35
Procuring 27,584 cubic yards of rock ballast:	
Quarry privilege	275.84
Quarry supplies	944.61
Labor, quarrying, hauling, and barging	24,963.52
Subsistence	1,007.00
Towage to points of expenditure	2,227.90
Total cost delivered on work, at $1.06 per cubic yard	29,418.87
Grading bank 11,385 linear feet, containing 140,120 cubic yards of earth:	
Labor	1,560.70
Subsistence	435.63
Supplies	483.14
Total cost, at 1¾ cents per cubic yard	2,479.47
Construction of mattress 12,244 linear feet, or 1,379,224 square feet:	
⅜-inch strand, 154,029 pounds	3,958.55
Labor, weaving and anchoring to bank	8,756.71
Subsistence	3,335.17
Total cost, at 1.16 cents per square foot	16,050.43
Ballasting mattress and bank (incomplete), 27,584 cubic yards placed to June 30, 1895:	
Labor	3,923.28
Subsistence	1,545.68
Total cost of placing, at 19.8 cents per cubic yard	5,468.96
Towage, moving construction parties, their plant and supplies	1,664.25
Total cost of 11,500 linear feet of revetment to June 30, 1895	70,845.33
Estimated cost of completion, procuring, and placing 7,250 cubic yards of rock ballast	10,000.00

Statement of liabilities incurred under allotment for systematic improvement in first reach, on account of improvement in Gasconade division, for each month of the fiscal year ending June 30, 1895.

Month.	Labor.		Construction material.	Plant material.	Plant purchased.	Subsistence stores.	Supplies.	Sundries.	Total each month.
	Administration.	All other items.							
July	$527.50	$620.55	.....	.....	$217.00	$143.54	$6.18	.....	$1,514.77
August	340.00	290.62	.....	.....	.....	144.07	143.54	.....	918.23
September	621.33	836.34	.....	.....	.....	504.77	103.02	$76.30	2,141.76
October	1,504.92	*12,832.57	$6,398.92	$1,302.29	1,031.18	2,325.47	654.84	30.31	26,080.50
November	1,727.28	*21,529.99	2,711.32	576.72	1,744.86	3,455.42	1,088.28	18.50	32,852.37
December	1,561.50	14,120.72	84.02	1,094.14	57.48	340.06	1,249.79	72.74	18,580.45
January	1,543.33	13,212.15	205.37	273.09	92.95	231.28	219.97	37.05	15,815.19
February	1,706.17	15,300.31	1,879.16	1,664.16	201.17	767.41	1,653.96	29.10	23,201.40
March	1,785.33	22,996.77	1,215.17	1,027.79	1,544.74	2,674.98	1,161.97	107.11	32,513.86
April	2,020.33	31,796.16	1,152.94	803.07	459.11	5,782.37	1,748.22	64.35	43,826.55
May	2,407.67	33,633.74	1,076.16	334.28	288.71	5,592.74	2,322.99	109.80	45,766.09
June	1,417.40	29,004.44	3,462.44	186.54	555.00	5,983.21	1,889.17	91.17	42,589.57
Total.	17,162.76	196,174.36	18,185.70	7,262.04	6,192.20	27,945.32	12,241.93	636.43	285,800.74

*These items include $1,155 for hire of steamer *Gasconade*.

Grand total of liabilities incurred on account of allotment for systematic improvement in first reach	$285,800.74
Less liabilities incurred for labor and subsistence in loading dike-construction materials, on account of Osage division	902.96
Total net expenditure during the year on account of improvement in Gasconade division	284,897.78

NOTE.—Deducting from the total expenditure of $284,897.78, as shown above, $4,574.76 for liabilities incurred and paid for prior to October 1, 1894, under allotment from appropriation act of March 3, 1893,

the cost to date of the revetment of St. Aubert Island, which was not provided for in the suballotment for Gasconade division, under act of August 18, 1894, amounting to $9,100.60, also the value of the construction materials and supplies on hand at the end of the year, amounting to $9,427.42, and which have been paid for by the said suballotment, a balance of $261,785 is arrived at for direct comparison with the expenditures as proposed in approved project of September 6, 1894, amounting to $259,977.

APPENDIX L.

ANNUAL REPORT OF MR. THEO. SCHOONMAKER, ASSISTANT ENGINEER.

MISSOURI RIVER COMMISSION,
St. Louis, Mo., June 30, 1895.

SIR: The following report of operations for the improvement of Osage River, Missouri, as far as they have come under my supervision during the year, is respectfully submitted:

It was thought necessary by Maj. Charles J. Allen (then in charge of the Osage) in June, 1894, to have more borings made to ascertain the character of the materials forming the river bottom at the site of Lock No. 1. The work of boring was begun on the 15th of June by drilling, with a 2½-inch drill, inside of a 3-inch gas pipe. The débris from the drill was removed by a sand pump at the end of a line. The pipe was driven by a wooden maul (operated by means of a rope and pulley at the top of a derrick erected on the drilling scow) each time when the drill reached the bottom of it, and extra lengths of pipe and drill were coupled on as the depth increased. The deepest boring was 27.7 feet below river bottom, and the depth reached 72.6 feet above the St. Louis Directrix.

In all, nine borings were made and a total depth of 170.6 feet bored. The bottom was found to be mostly gravel of rather small size interspersed with thin strata of sand and clay, very little clay being encountered.

No rock was found except that forming the bluff on the right bank of the river, and the slope of that under water and river bottom was so steep that it was considered impossible, without unwarranted expense, to build both walls of a lock of the size proposed with their foundations resting on it. The location of the lock on the left bank was not changed. Cross sections were taken there and the necessary data obtained for making an estimate of cost. The plans for the lock previously proposed were revised to correspond with the latest information, and specifications were written and estimates made in accordance therewith.

In September, 1894, a line of levels was run from the lock site to the mouth of Osage River to check the levels run previously.

A profile of the river from the lock site to the mouth and down through Osage Chute to Bonnots Mill on the Missouri was made, to assist in the determination of the proper elevation of the lower miter sill of the lock. In the Osage River from the lock to the mouth there is no fall at low water, while from the mouth to Bonnots Mill there is a fall of 3 feet in about 3 miles. The building of the dam from Osage Point to Dodds Island, shutting off communication between the Osage and the Missouri, at the mouth of the former, practically makes Osage Chute a part of the Osage River. It will be necessary to regulate the low-water channel in this chute by dikes, as is done in the Missouri, in order to maintain the proper depth for navigation at low water.

In November, 1894, a plane table survey was made from the lock site to a point 30 miles up the river, using the maps of previous surveys as a basis, to ascertain the additional area of land which would be overflowed by a high freshet (20.6 feet on the gauge) in case a dam was built.

In the 30 miles thus surveyed the quantity of land overflowed by a freshet of this height, with the river in its present unobstructed state, was found to be 3,276 acres, and with a dam of the proposed lift of 10½ feet the quantity would be 3,912 acres, an increase of about 20 per cent. Because of this increased area of overflow it would seem desirable to modify the plan of dam, and instead of the 10½-foot lift full stationary dam to build a dam of lower stationary lift, and to make up the necessary height by the addition of a needle dam on top of the stationary structure. This needle dam could be raised at times of low water, thus keeping the pool at the proper level, and be lowered during high water.

This construction would avoid the flooding of the additional area of tillable land and give some of the benefits to be derived from the construction of a full movable dam like those now in use on the Ohio and Great Kanawha rivers.

By lowering the stationary lift the tendency toward erosion of the banks below the dam will be diminished and boats may pass over it at moderately high stages of water. As no cofferdam would be needed for this sort of structure the expense would not be materially greater than for the full-height stationary dam, and would be very

much less than for the full movable dam, as shown by plans and estimates heretofore submitted to the Missouri River Commission.

In April, 1895, three experimental piles were driven at the lock site to further test the character of the river bottom.

The piles were driven with a Cram hammer weighing 5,500 pounds, with a fall of 2 feet 6 inches. The greatest penetration was 36½ feet. The penetration to the blow was three-quarters of an inch for the 7 feet between 18 to 25 feet penetration. The points of the piles when driven were at an elevation of from 67 to 67.5 feet above the St. Louis Directrix. The bottom of the deepest boring, as before noted, was at 72.6 feet.

A delay in the enactment of legislation by the State of Missouri to give the United States exclusive jurisdiction over the land purchased for the lock site delayed the letting of contracts, but bids for building a portion of the lock were opened May 18, 1895.

A contract was made with the lowest bidders, McGee, Kahmann & Co., of Kansas City, Mo.

Preliminary work has been begun, but the backwater from the June rise in the Missouri will interfere with active operations for some two weeks or more.

Plans and specifications for a lock house, office, and outbuildings having been prepared, bids for their construction were opened February 21, 1895.

The contract was made with Matthew J. Brennan, but not until March 27, owing to the lack of exclusive jurisdiction, as above noted. The buildings are completed and ready for occupancy. The necessary fencing and walks have been built, and a well has been bored by means of the same appliances used in making the test borings.

Very respectfully, your obedient servant,

THEO. SCHOONMAKER. *Assistant Engineer.*

APPENDIX M.

ANNUAL REPORT OF MR. L. P. BUTLER, ASSISTANT ENGINEER.

OFFICE MISSOURI RIVER COMMISSION,
St. Louis, Mo., May 31, 1895.

SIR: I have the honor to submit the following report on the work of improving the Gasconade River at Pryors Mill, Missouri, during the months of March and April, 1895:

The work to be done at this point was the protection of the bank on the west side of Pryors Island, where the narrowness of the lower end of the island made danger of a cut-off occurring, which would decrease materially the water in the navigable channel.

The estimates for this work were for a revetment of 600 linear feet, based on a recommendation made after an examination in the spring of 1894. On arriving on the ground in 1895 it was decided to attempt to build 760 feet in length at the risk of having the revetment incompleted as to width. This would allow the taking advantage of an irregularity in the shore line of the protection of the upper end of the revetment and the extending of the revetment as far down the river as the bank was cutting, though not as far up.

The work of revetting the bank, as set forth in specifications that you gave to me, was to consist—

First. Building a mattress and sinking it close to the shore line.

Second. Driving piles 4 feet apart through the edge of the mattress next the shore.

Third. Filling the space left between the piles and the shore with brush and rock ballast.

Fourth. Grading the bank.

Fifth. Rocking the graded bank.

A quarry was opened March 18 in the side of the bluff on right bank of river about one-half mile above the proposed revetment. The quarry force consisted of one foreman and five laborers. Work at the quarry was continued until noon of March 29, when 168 yards of rock had been gotten out in nine and three-fourths working days.

The pile driver arrived on the evening of March 24.

The failure of a sawmill owner to furnish lumber ordered of him for use in building outrigger on barge delayed the work until the lumber could be procured from another dealer. The high stage of water, however, from March 24 to April 1 would probably have made the construction of the mattress at that time unsafe.

On April 3 the pile-driver leads were raised into position, and the outrigger from which mattress was to be constructed was built on the forward end of the pile-driver barge.

The making of the mattress was begun April 4. The mattress was constructed of willows laid perpendicularly to the direction of the current and bound together by wire running longitudinally.

The wire was laid in five pairs 3½ feet apart, one wire of a pair lying below and the other above the willows, and pin twisted together every 2½ feet, the twists of two adjacent pairs alternating with each other.

The width of the mattress was 20 feet, the length of the willows.

Six men were used in building mattress. Four men carried the willows to the platform while two arranged them. When the platform was covered the top wires, which were kept in coils, were carried over and the pin twists made by the two men who had placed the willows, each assisted by two of the carriers, who separated the willows and kept the wires of equal tension.

All hands then lowered the barge until the mattress built slid to the lower edge of the platform and the platform was again covered.

The thickness of the mattress was kept between 6 and 8 inches. The willows ranged in thickness from 1½ to 3 inches at the butts. Lighter willows would have been more easily and quickly handled, but the mattress when completed appeared to be strong and as flexible as desired.

The upper end of the mattress was made fast to trees on the bank by wires extended ahead. The mattress as built floated on the surface of the water and was held in to the curve of the shore by lines every 50 or 100 feet, which were cut after the mattress had been sunk.

The construction of the mattress consumed five days and 542 linear feet were made, making an average of 108.4 feet per day. The minimum number of feet constructed in a day was 56 feet, on the first day, and the maximum was 136 feet.

Forty-five cords of willows were used in mattress, or 12 cords of willows to 100 feet of mattress.

On the last day, April 10, of mattress building, was begun the decking of a barge lent by Mr. William L. Heckmann. April 11 was also used for decking the barge.

On April 12, 235 feet of mattress was sunk, and on April 13 the remaining 307 feet was sunk. Twenty-four yards of rock were used in sinking mattress, or 4.43 yards of rock to 100 feet of mattress.

On April 13 the pile-driver engine was put in place. Pile driving was begun the following Monday at the upper end of the mattress.

Trouble at the outset with the inspirator, which was finally taken to Chamois for repair, and the necessity of continually repairing the leads, which were very much worn, were causes of delay in driving piles.

One hundred and eighty-three piles were driven, occupying seven and one-half days, making an average of 24.4 piles per day. The minimum number of piles driven in a day was 1 pile, and the maximum, 33 piles.

The piles were 12 feet long and driven to a penetration of 8 feet.

One engineman and five laborers were used in driving piles, while two men sharpened, squared ends, and rafted piles to point where used.

While the pile driving was going on the work of placing brush behind the piles, weighing this down with rock, and grading and rocking the bank was begun. Each operation followed that preceding as quickly as was possible with the plant at hand, which consisted of one barge used for mattress making and driving piles, and one barge used for transporting rock and carrying 12 yards at one load.

Barging rock for backing and paving graded bank was begun April 19. Grading was begun April 20.

At times there were separate forces at work barging rock and grading the bank, but the greater part of the grading was done by the barge force at those times when it had unloaded the barge before the end of the working day, but had not time to make another trip.

The brush was placed by men taken, when needed, from the same force.

This force varied from six to fourteen men, and the work continued from April 19 to April 27.

An extra force of one foreman and six men was worked in the quarry for one and one-half days near the end of the work, getting out 24 yards of rock, making a total of 192 yards quarried.

In the backing were used 18 cords of brush, oak saplings, and 144 yards of rock.

On the lower 218 feet of revetment, not covered by mattress, 14 cords of willows and oak saplings were laid between the piles and projecting 10 feet beyond them. The backing placed on top of the inshore ends of this brush and some rock outside of the piles hold this brush in place.

Snagging was carried on at the same time with the other work. Nine days were spent snagging with a force varying from four to eight men, depending upon the work to be done.

Snags were removed and destroyed as follows:

At lower end of revetment: One tree, 3 feet in diameter, about 70 feet long; one tree, 2 feet in diameter, about 60 feet long; one tree, 20 inches in diameter, about

40 feet long; one tree, 2 feet in diameter, about 35 feet long; one stump, 4 feet in diameter, about 10 feet long, with heavy root; fifteen trees, varying in size from 10 to 15 inches in diameter and about 30 feet long.

At upper end of revetment: One tree, 1½ feet in diameter, about 50 feet long; five trees, 10 inches in diameter, about 40 feet long, rooted together.

At bar opposite revetment: One tree, 3½ feet in diameter, about 35 feet long; one tree, 2 feet in diameter, about 40 feet long; three stumps.

At bend opposite revetment: One sycamore tree, 2½ feet in diameter, about 70 feet long.

Snags were pulled with a windlass placed on the high bank, with the exception of those at the upper end of the revetment, which were pulled with the pile-driver engine.

Additional piles were driven as follows, the further work of revetting to be done by private parties:

For 320 feet of bank immediately above and as a continuance of revetment built 80 piles were driven.

For 150 feet on left bank of river, at lower end of Pryors Island, 37 piles were driven.

For 395 feet on left bank of river, in reversed bend above the revetment built, 79 piles were driven; these last being placed 5 feet apart.

These additional piles were driven in six days, making an average of 36 piles per day.

The revetment as far as completed and left May 10, 1895, when the allotment for work at that point had been expended, consists of 760 linear feet of driven piles with mattress protection in front for 542 feet and laid brush for the remaining 218 feet, rock backing the whole length, graded bank for 300 feet, and rocked bank for 175 feet.

Cost of work.—All of the brush, 55 cords of willows and 22 cords of oak saplings, also 33 piles, were furnished by Mr. William L. Heckmann. The remaining piles, 346 in number, were furnished by Mr. S. M. Lambeth (309) and Mr. Wesley Cox (37).

Cost of snagging and additional pile driving.

Classification.	Material.	Labor.	Per unit.	Total.
Snagging	.....	$85.75	.....	$85.75
Additional pile driving (196)	$8.90	57.00	$0.3362	65.90

Cost of 760 linear feet of revetment on Pryors Island.

Classification.	Material.	Labor.	Per unit.	Total.
Repairs to pile driver	$20.50	$82.84	.....	$103.34
Towage of pile driver	.....	.....	.....	35.00
Clearing bank	.....	12.00	.....	12.00
Quarrying rock (192 yards)	16.02	115.27	$0.6838	131.29
Building outrigger on barge	11.58	13.00	.....	24.58
Making mattress (542 linear feet)	12.02	45.00	.1052	57.02
Decking barge	20.14	13.31	.....	33.45
Sinking mattress (542 linear feet)	.....	13.50	.....	13.50
Driving piles (183)	5.25	88.00	.5096	93.25
Transporting and placing rock (192 yards)	.....	91.69	.4775	91.69
Grading and placing brush	.....	44.06	.....	44.06
Placing machinery and loading	.....	23.75	.....	23.75
Timekeeper	.....	15.00	.....	15.00
Watching plant	.70	76.50	.....	77.20
Foreman	.....	105.00	.....	105.00
Total	.....	.....	.....	$860.13

Very respectfully, your obedient servant,

L. P. BUTLER, *Assistant Engineer.*

Lieut. J. C. SANFORD,
Corps of Engineers, U. S. A., Secretary Missouri River Commission.

MISSOURI RIVER COMMISSION.

OMAHA DIVISION

MAP OF

MISSOURI RIVER

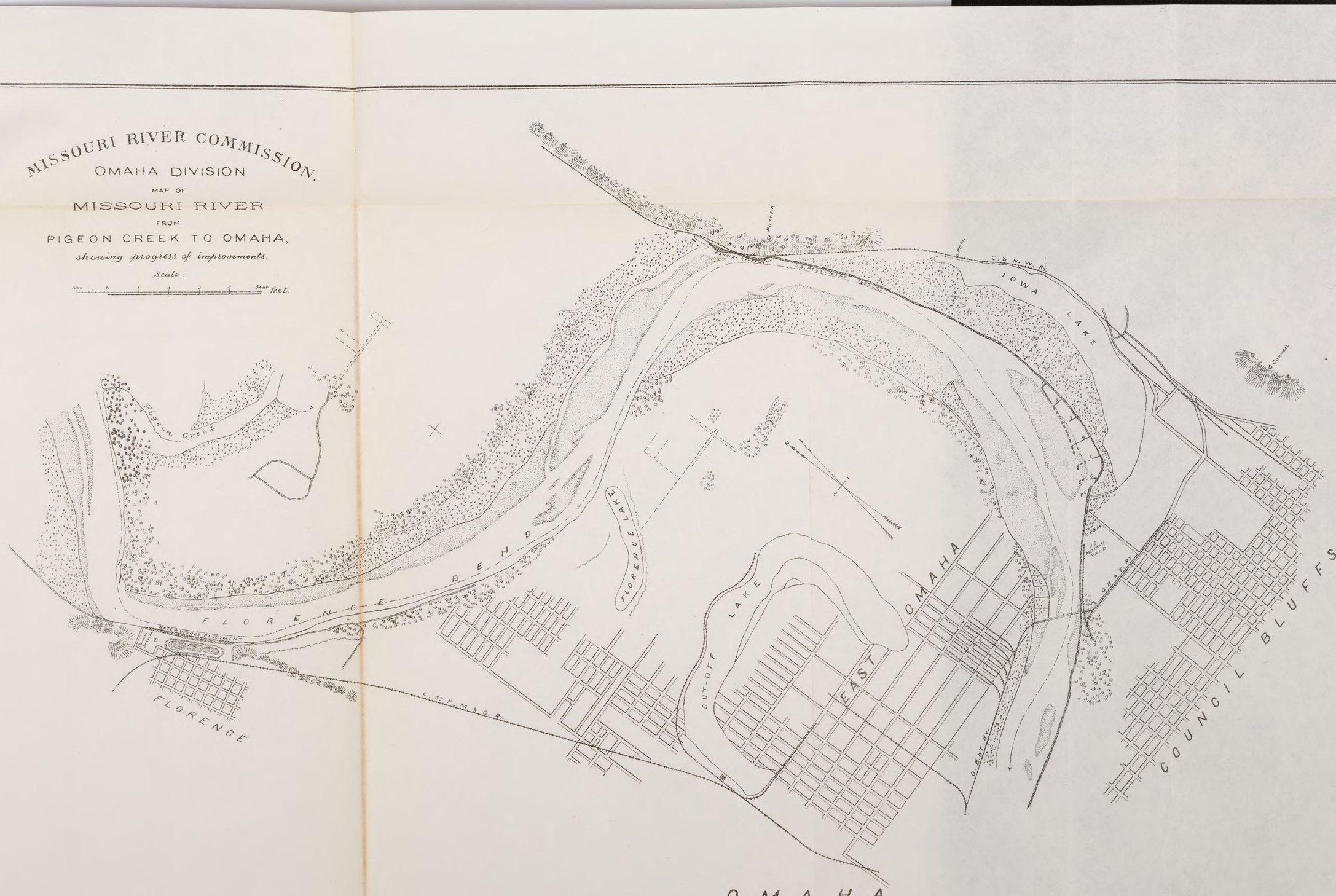
FROM

PIGEON CREEK TO OMAHA,

showing progress of improvements.

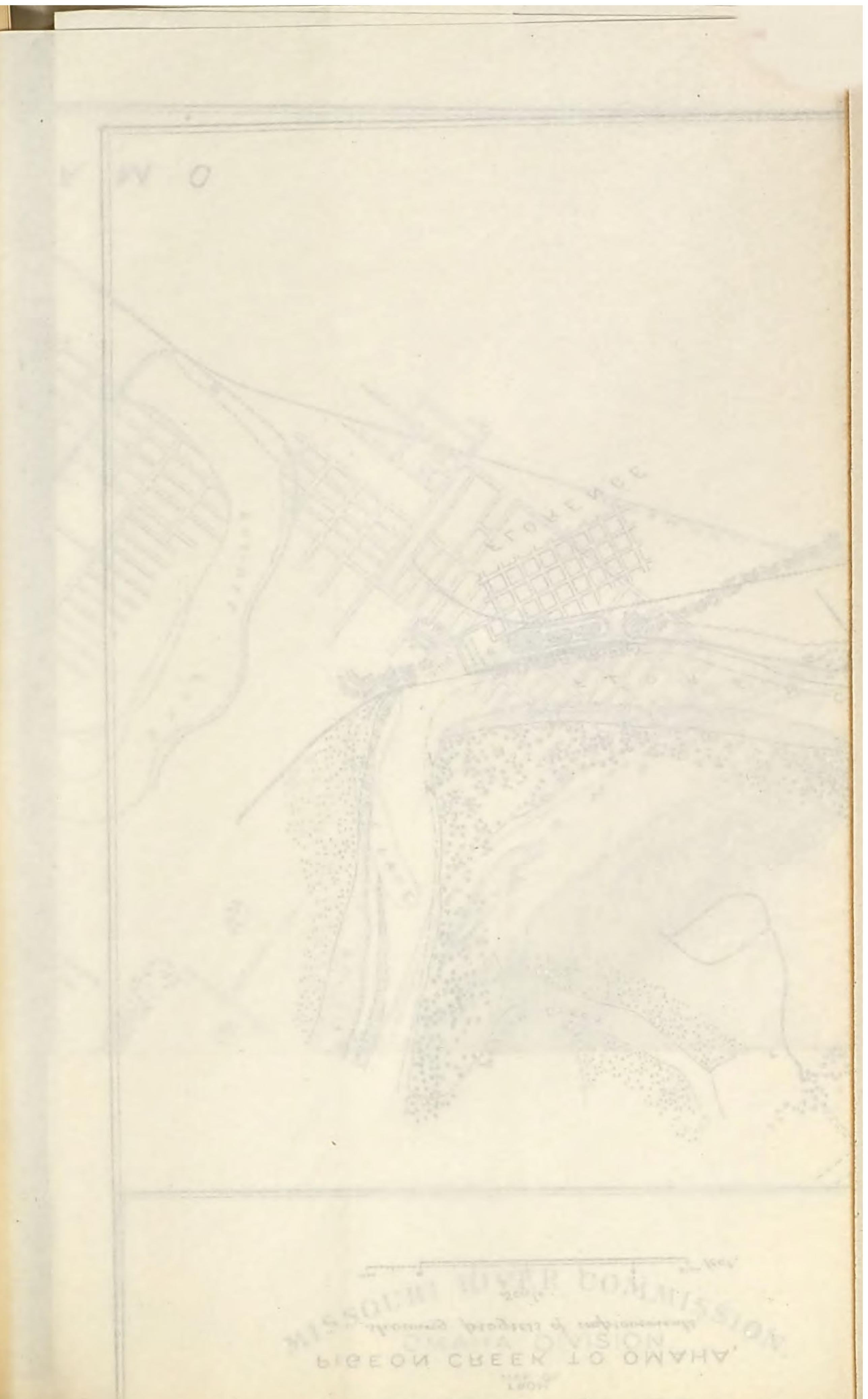
Scale:

1000 0 1 2 3 4 5000 Feet.



To accompany annual report for 1895 of S.C. Meredith, Div'n. Eng'r.

Eng 54 1



MISSOURI RIVER COMMISSION

OMAHA DIVISION

MAP OF

MISSOURI RIVER

IN THE VICINITY OF

ST. JOSEPH, MO.

SHOWING BREAKS REPAIRED IN BELMONT BEND.

SCALE:

1000 0 1 2 3 1000 Feet.



To accompany annual report for 1895. of J. C. Meredith, Div Engr.

MISSOURI RIVER COMMISSION

OMAHA DIVISION

MAP OF

MISSOURI RIVER

IN THE VICINITY OF

ST. JOSEPH, MO.

SHOWING BANKS REVETED IN DEFENSE WORK.

SCALE

MISSOURI RIVER COMMISSION.

OMAHA DIVISION

MAP OF

MISSOURI RIVER

IN THE VICINITY OF

ST. JOSEPH, MO.,

Showing Breaks Repaired in Bonton Bend.

Scale:

1000 0 1 2 3 4000 ft.



To accompany annual report for 1895 of J. C. Meredith, Div'n. Engr.

Eng 54 1

MISSOURI RIVER

MAP OF

OMAHA DIVISION

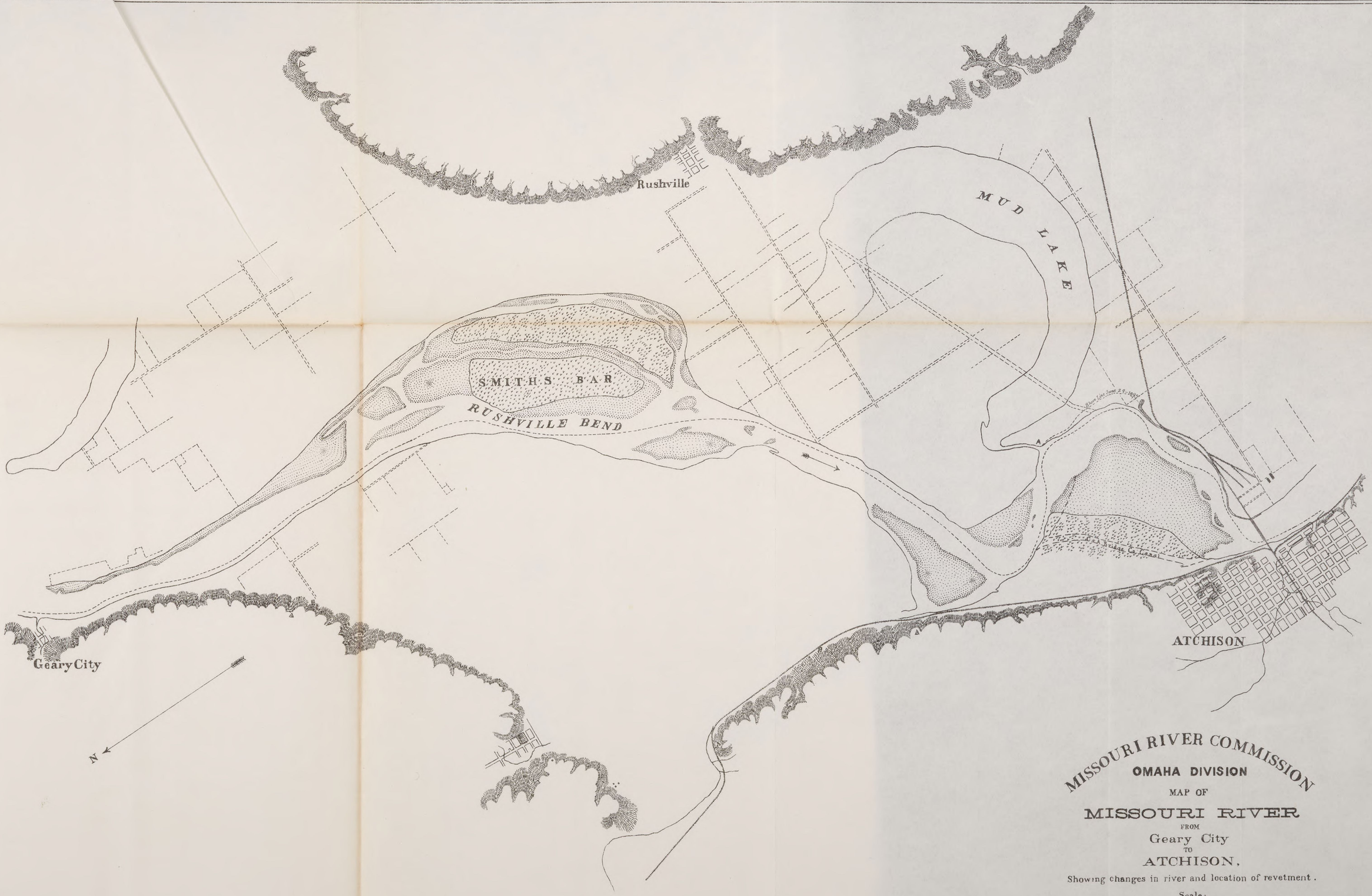
IN THE VICINITY OF

ST. JOSEPH, MO.

Showing Levees Proposed in Pottawattamie County, Iowa.

Scale:

MISSOURI RIVER COMMISSION



MISSOURI RIVER COMMISSION

OMAHA DIVISION

MAP OF

MISSOURI RIVER

FROM

Geary City

TO

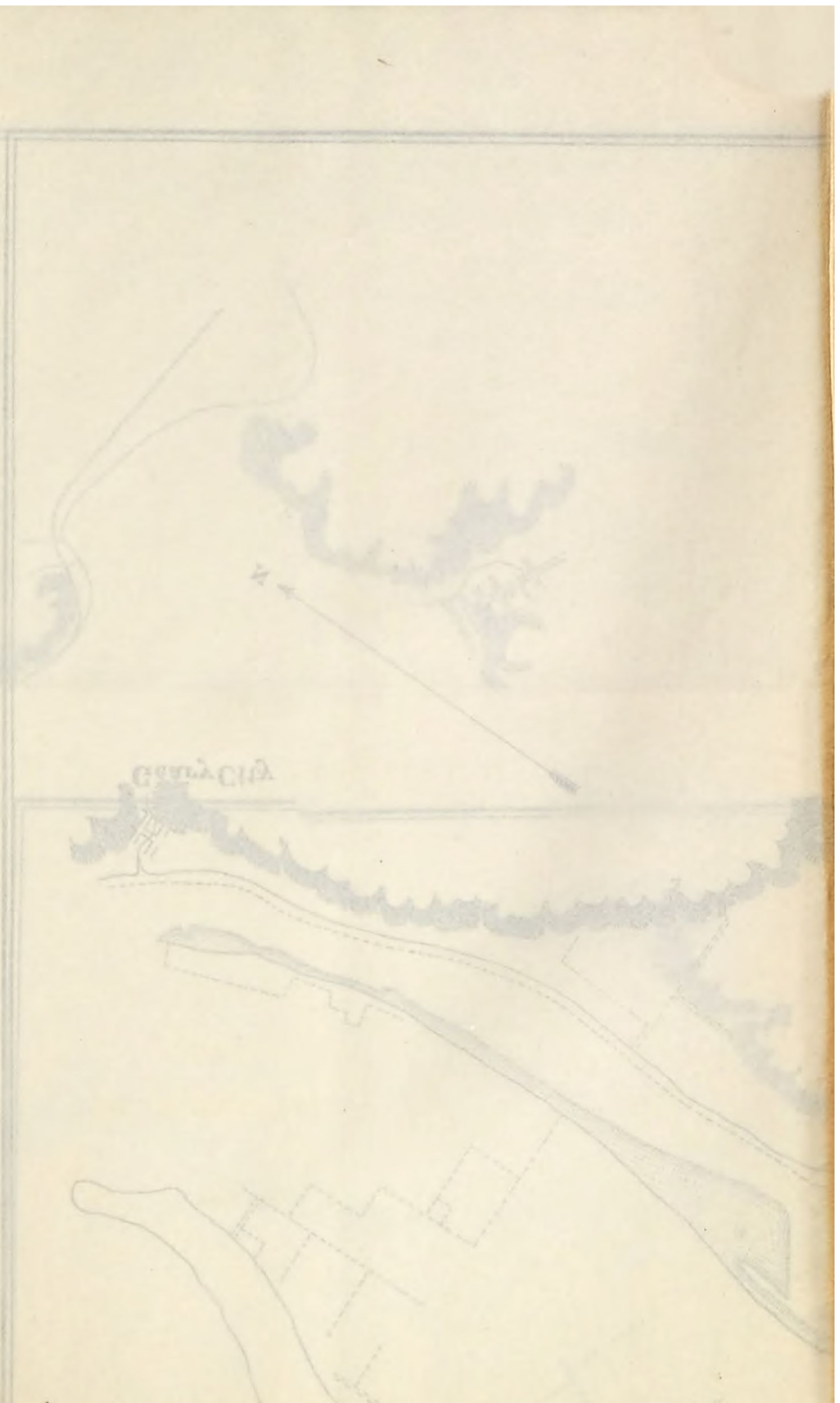
ATCHISON.

Showing changes in river and location of revetment.

Scale:

1000 0 1 2 3 4 5000 ft.

To accompany annual report for 1895 of J. C. Meredith, Div. Engr.



MISSOURI RIVER COMMISSION

OMAHA DIVISION

MAP OF

MISSOURI RIVER

FROM

FORT LEAVENWORTH

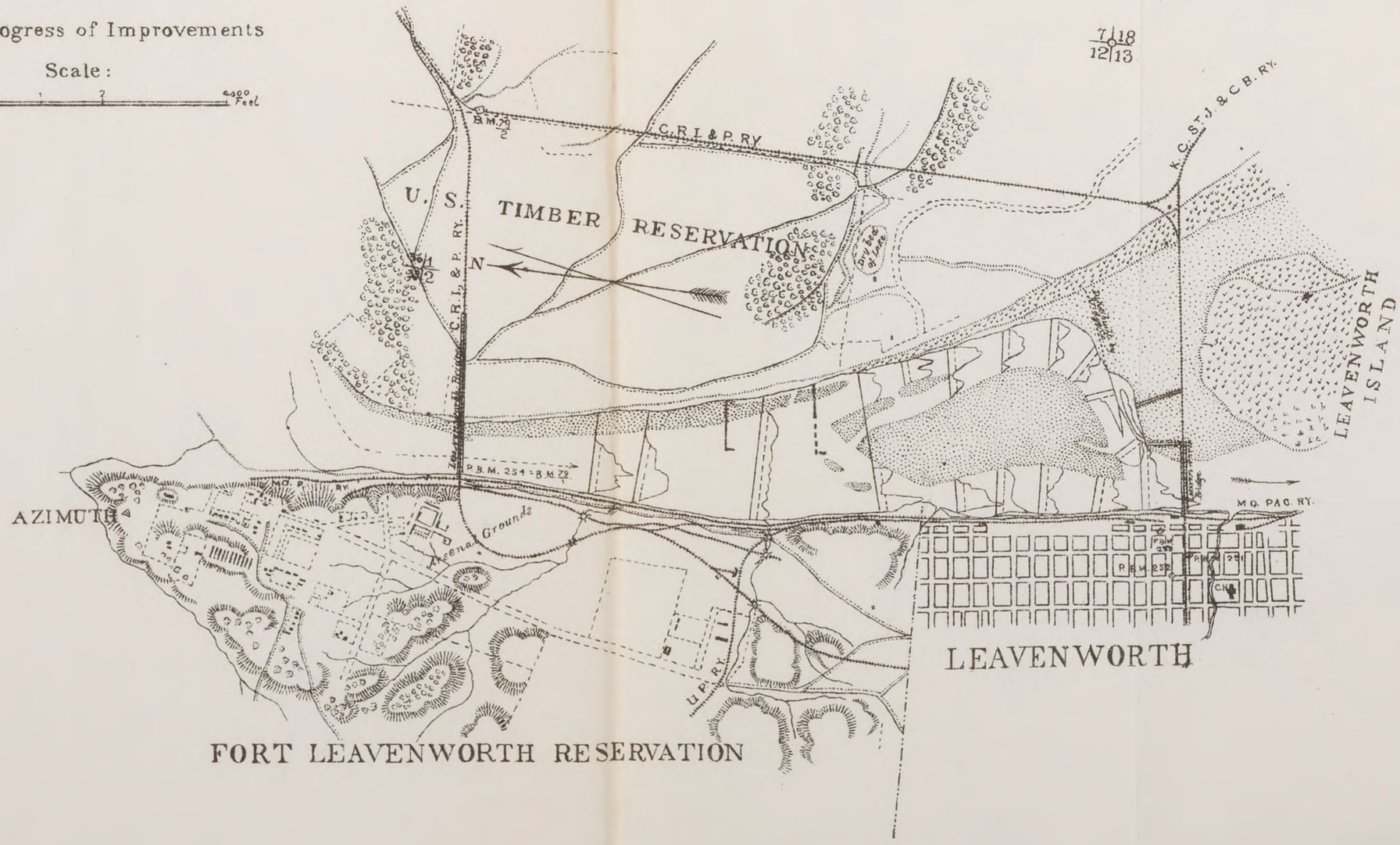
TO

LEAVENWORTH,

Showing Progress of Improvements

Scale:

1000 0 1 2 4000 Feet



To accompany annual report for 1895 of J.C. Meredith, Div. Eng'r

Eng 54 1

MISSOURI RIVER COMMISSION
OMAHA DIVISION

MAP OF

MISSOURI RIVER

FROM

FORT LEAVENWORTH

TO

LEAVENWORTH.

Showing Progress of Improvements

Scale

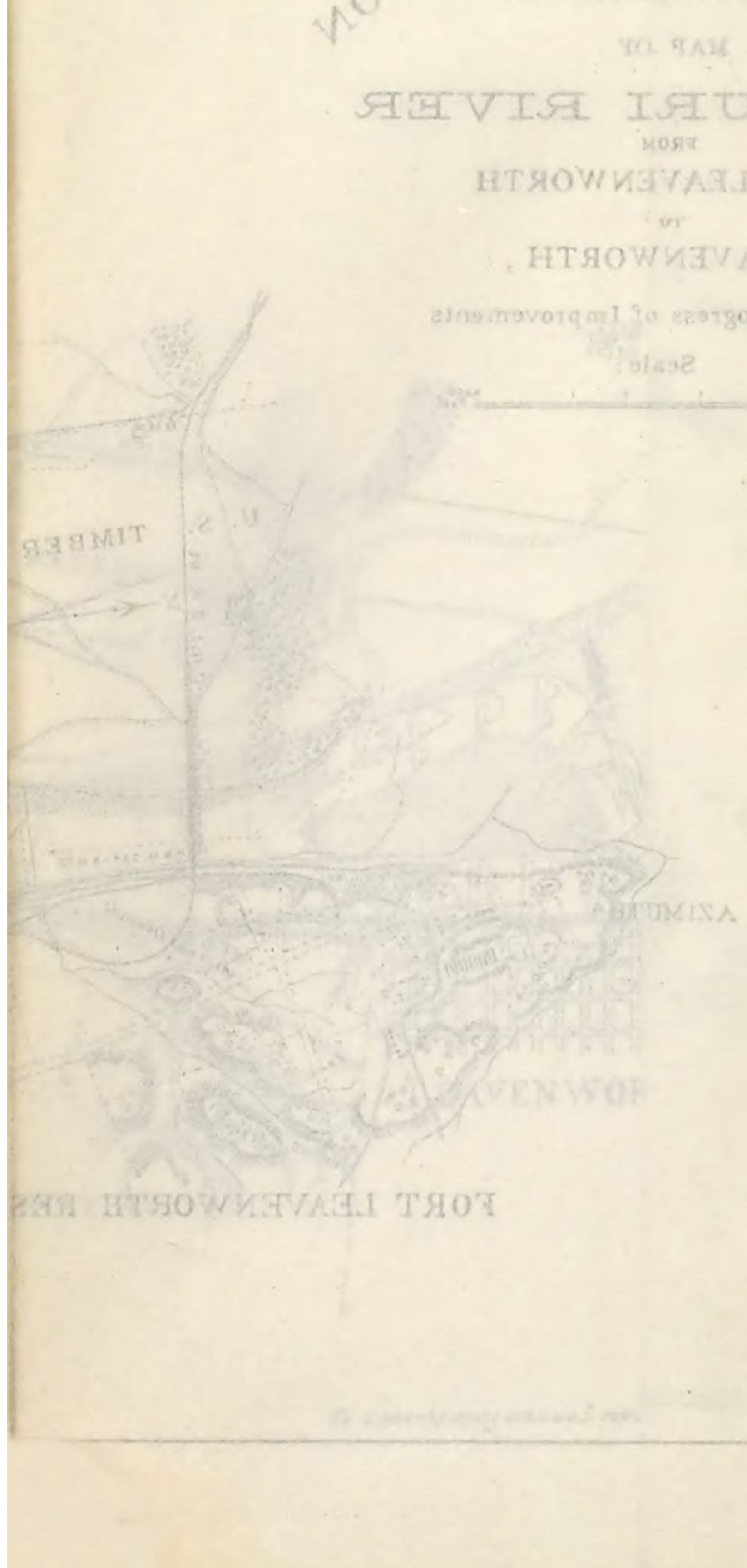
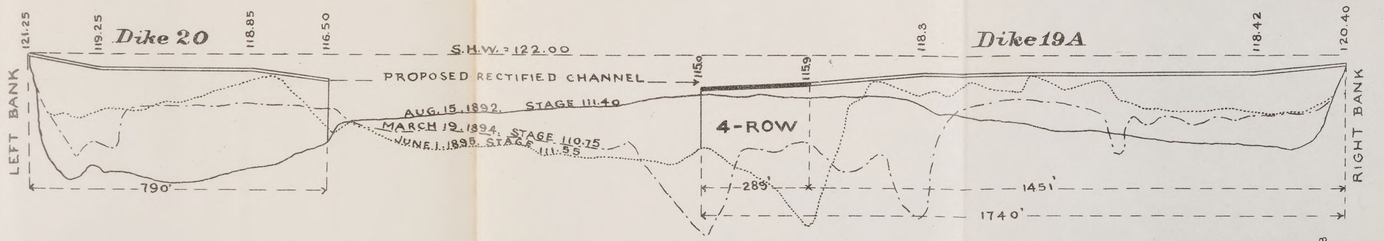
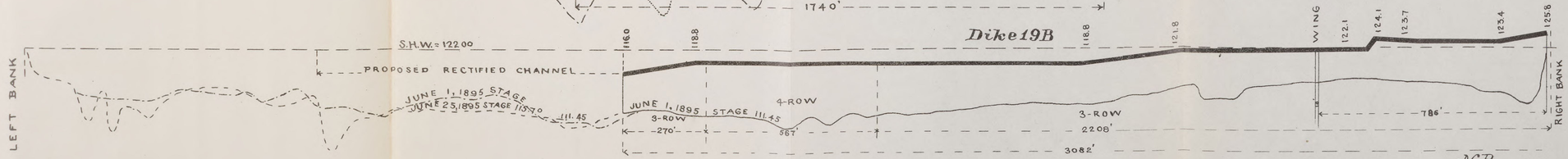
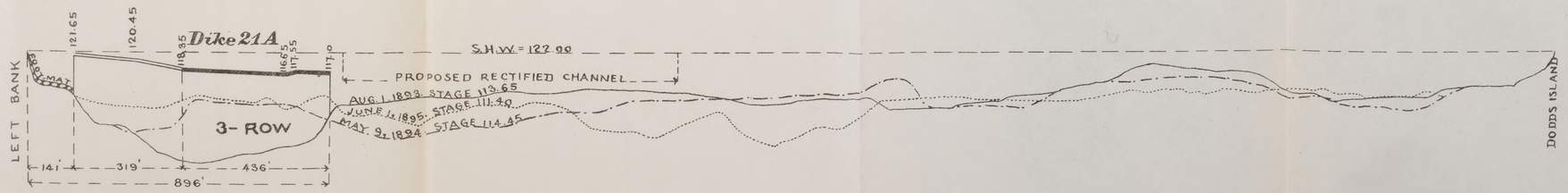


PLATE I









MISSOURI RIVER COMMISSION,

OSAGE DIVISION, FIRST REACH.

Profiles of Dikes and Cross-Sections of River.

Scales:

HORIZONTAL 100 0 500 Feet.

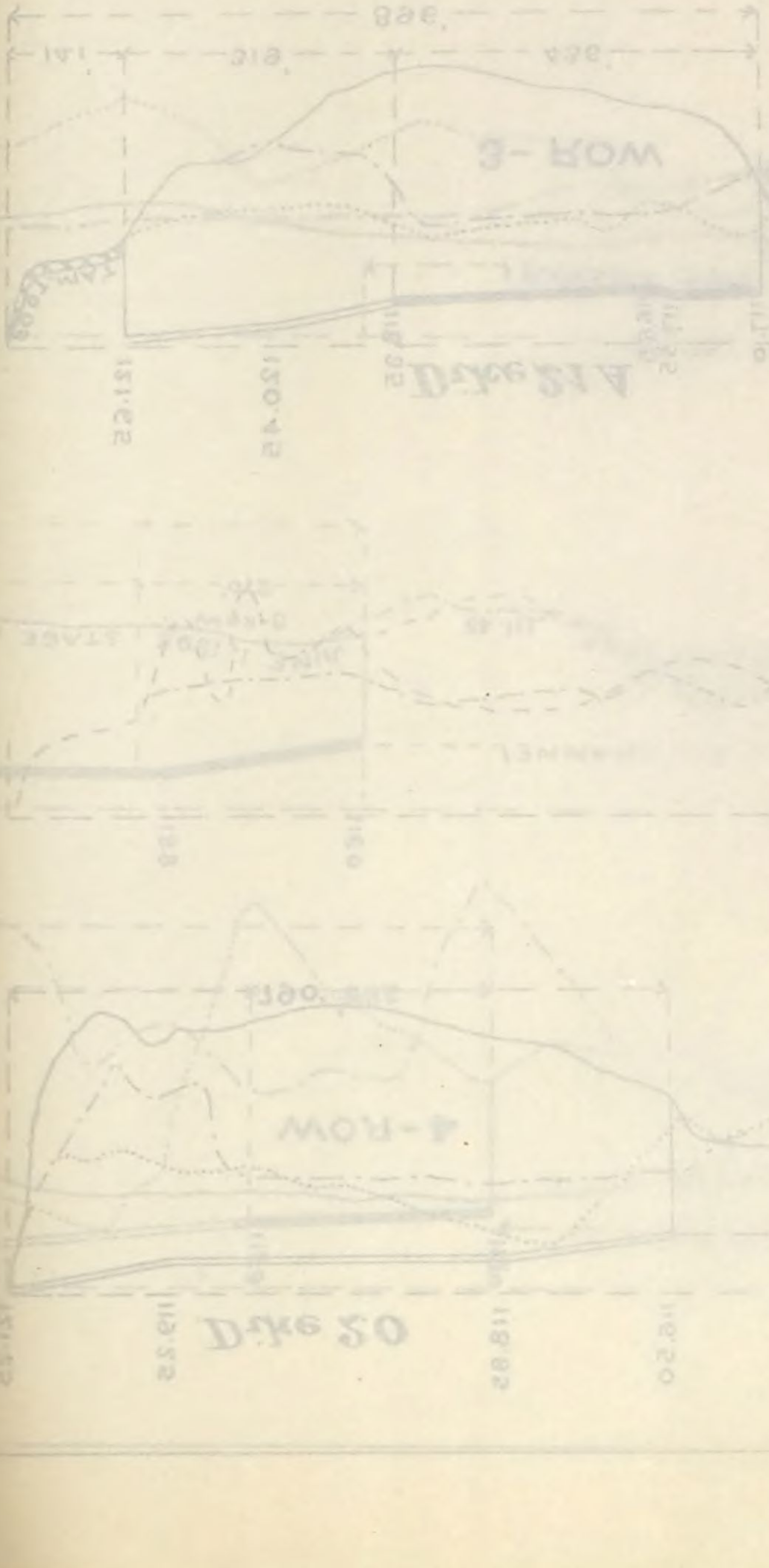
VERTICAL 10 0 40 Feet.

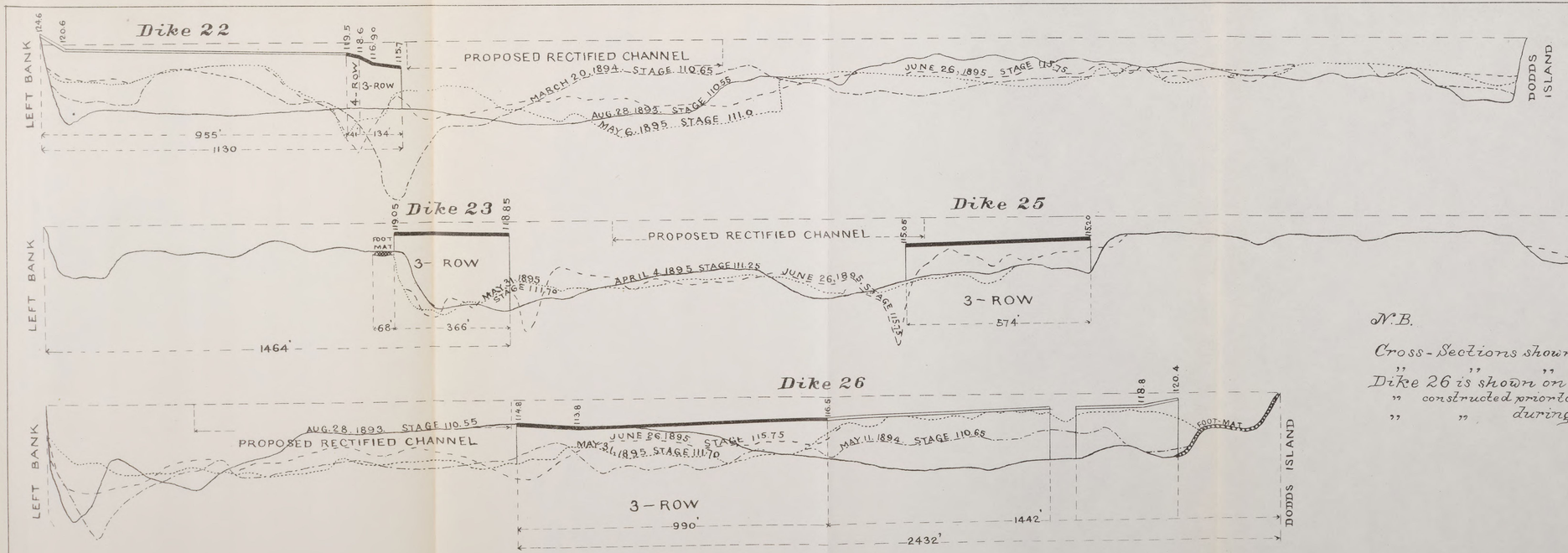
NB.

Dikes 19A and 20 are shown with cross-sections sounded on line of dikes.
Dike 21A is shown with cross-sections sounded on line of dike.
Dike 19B, between right bank and stream end, is shown with cross-section sounded on line of dike, and, between stream end and left bank, on normal cross-sections 400 feet below the dike.
Dikes constructed prior to fiscal year of 1895 shown thus ═══
" " during " " " " " " ▬▬▬

To accompany annual report for 1895, of Lt. Col. H. Yonge, Div. Engr.

Eng 54 1





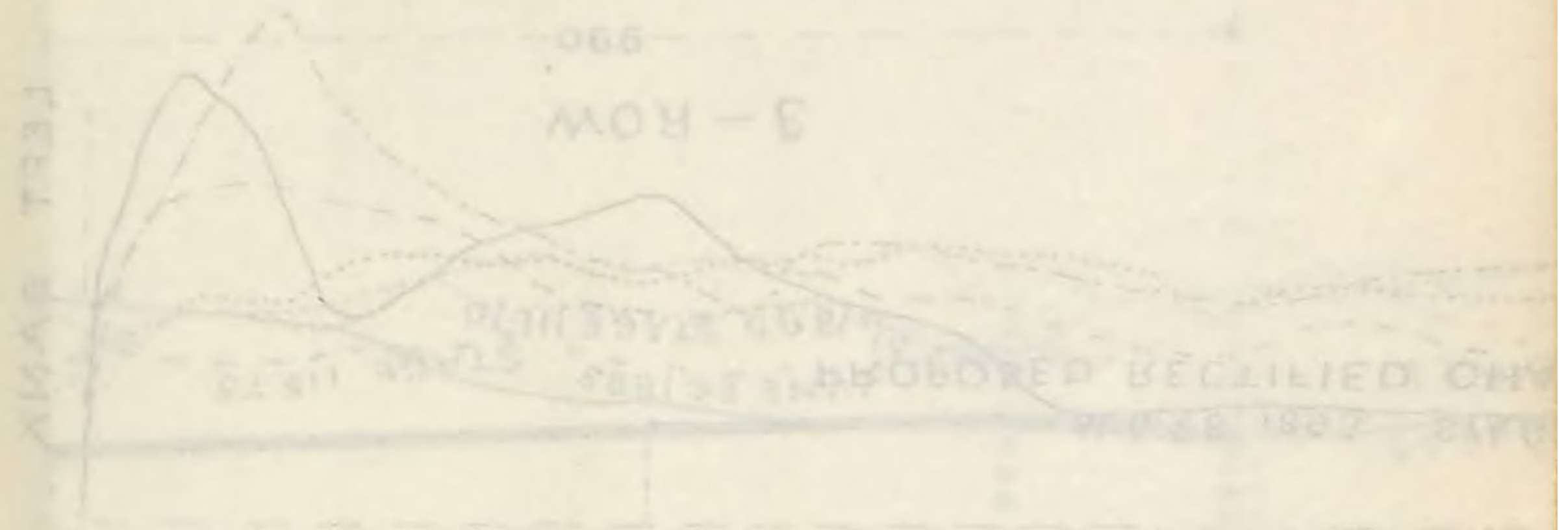
MISSOURI RIVER COMMISSION,
OSAGE DIVISION, FIRST REACH.
Profiles of Dikes and Cross-Sections of River.
Scales:
HORIZONTAL 100 0 500 Feet.
VERTICAL 10 0 40 Feet.

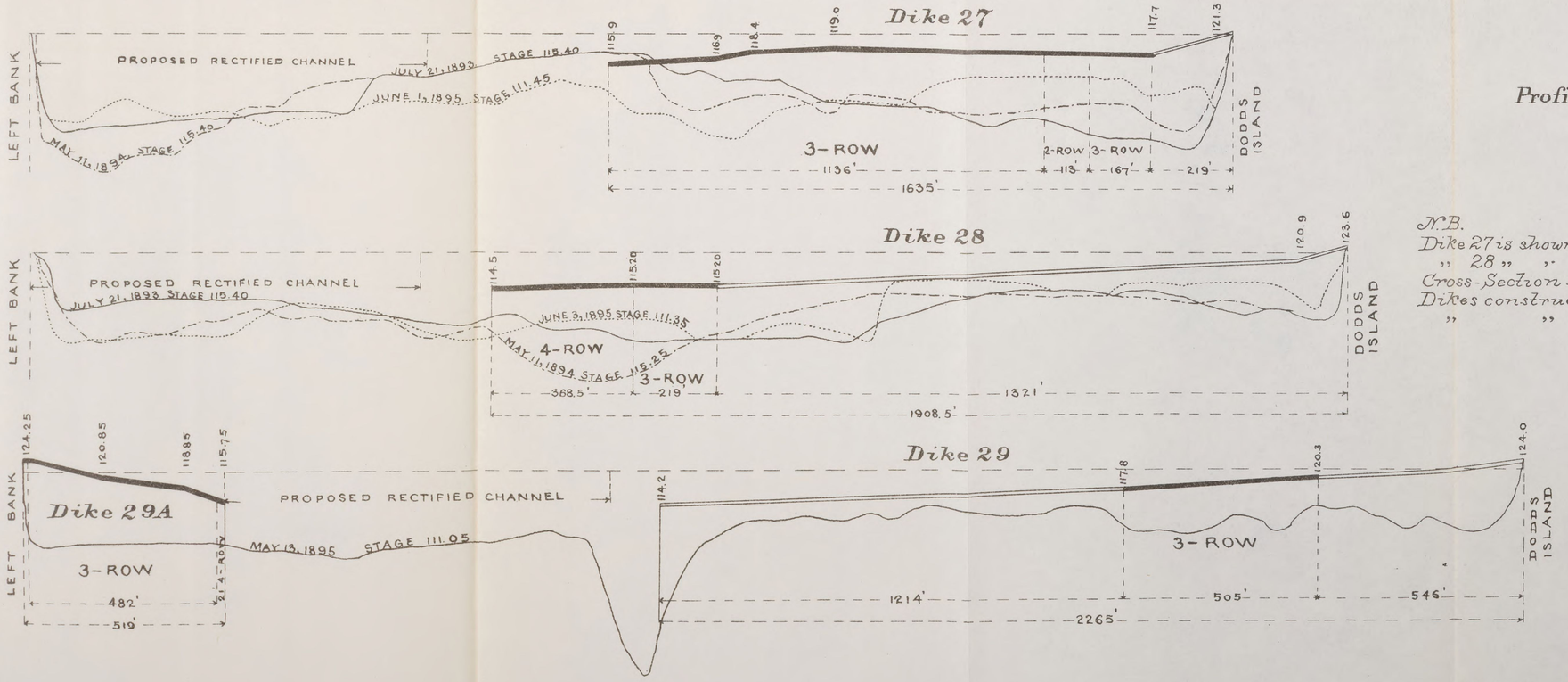
N.B.

Cross-Sections shown with Dike 22 were sounded on line of dike.
" " " " " " 23 and 25 " " " " " "
Dike 26 is shown on cross sections sounded between Dike 26 and 27
" constructed prior to fiscal year of 1895 shown thus ═══
" " during " " " " " " ═══

To accompany annual report for 1895 of Sam'l H. Yonge, Div. Engr.

Eng 54 1





MISSOURI RIVER COMMISSION,

OSAGE DIVISION, FIRST REACH.

Profiles of Dikes and Cross-Sections of River.

Scales:

HORIZONTAL 100 0 500 Feet

VERTICAL 10 0 40 Feet.

N.B.

Dike 27 is shown on cross-sections sounded between Dikes 27 and 28.

" 28 " " " " " " " " 28 " 29.

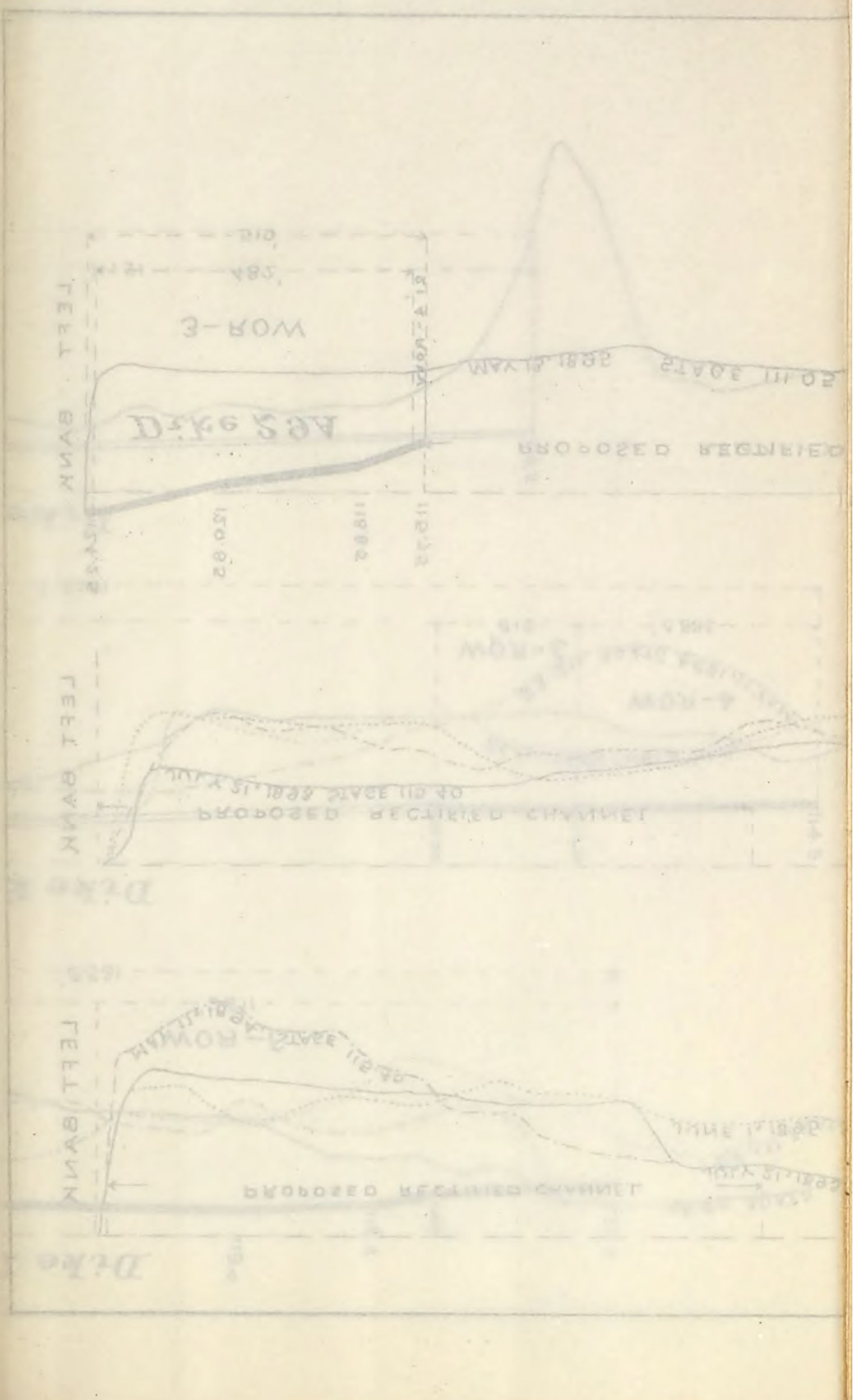
Cross-Section shown with Dikes 29 and 29A was sounded on line of dikes

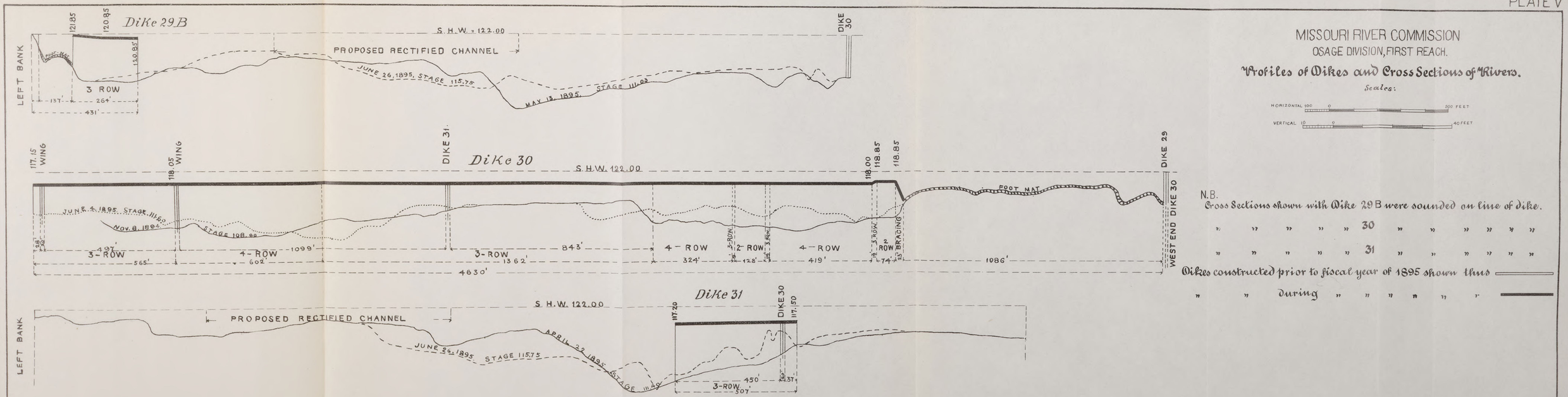
Dikes constructed prior to fiscal year of 1895 shown thus ═══

" " during " " " " " " ▬▬

To accompany annual report for 1895, of Sam'l H. Yonge, Div Eng'r.

Eng 54 1





MISSOURI RIVER COMMISSION

OSAGE DIVISION, FIRST REACH.

Profiles of Dikes and Cross Sections of Rivers.

Scales:

HORIZONTAL 100 0 500 FEET

VERTICAL 10 0 40 FEET

N.B.

Cross Sections shown with Dike 29 B were sounded on line of Dike.

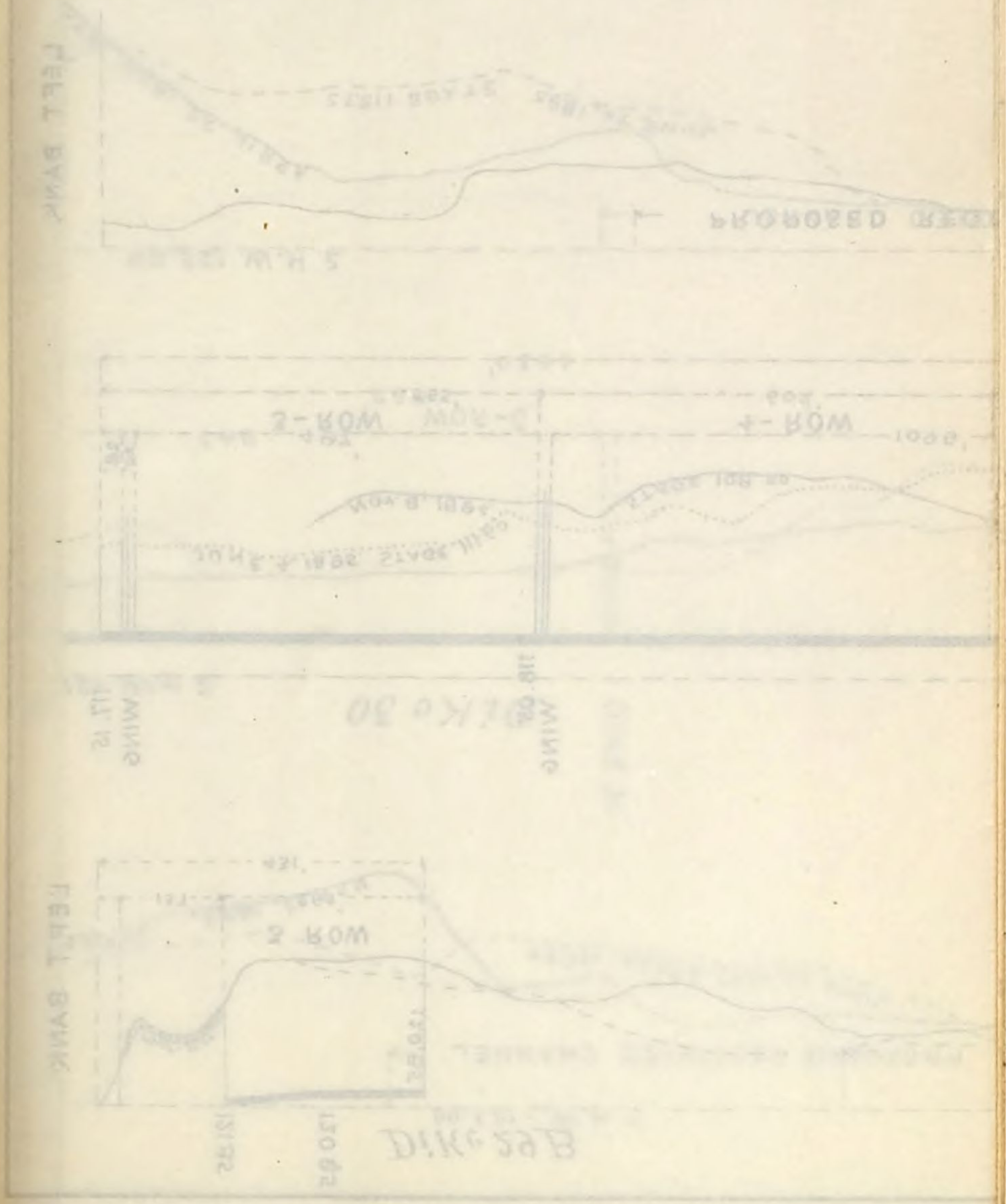
" " " " " 30 " " " " " "

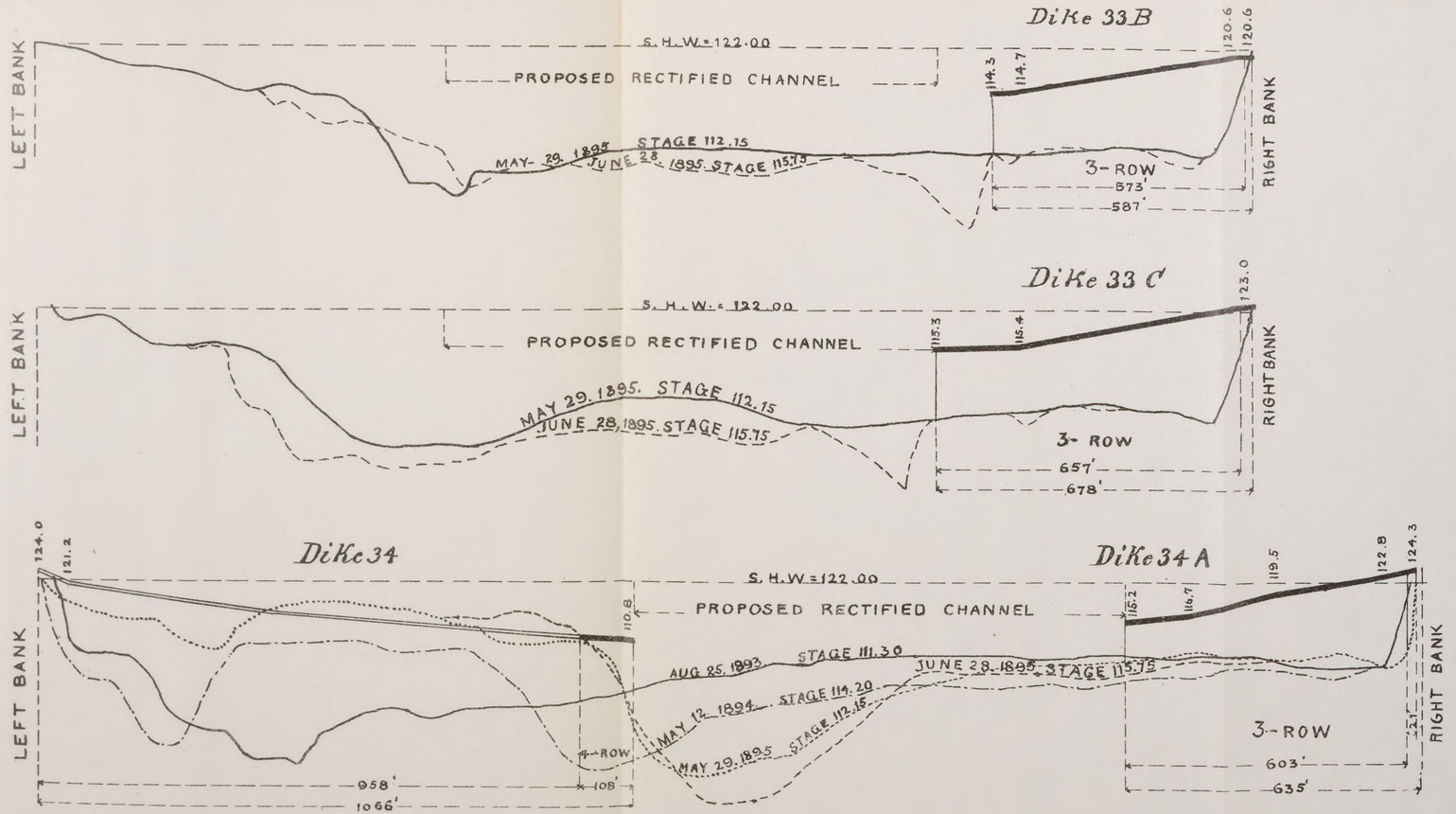
" " " " " 31 " " " " " "

Dikes constructed prior to fiscal year of 1895 shown thus ——

" " during " " " " " " ——

To accompany Annual Report for 1895, of Sam'l H. Yonge, Div. Engr.





MISSOURI RIVER COMMISSION.

OSAGE DIVISION, FIRST REACH

Profiles of Dikes and Cross Sections of River.

Scales:

HORIZONTAL 100 0 500 FEET.

VERTICAL 10 0 40 FEET.

N.B.

Cross Sections shown with Dike 33 B were sounded on line of dike

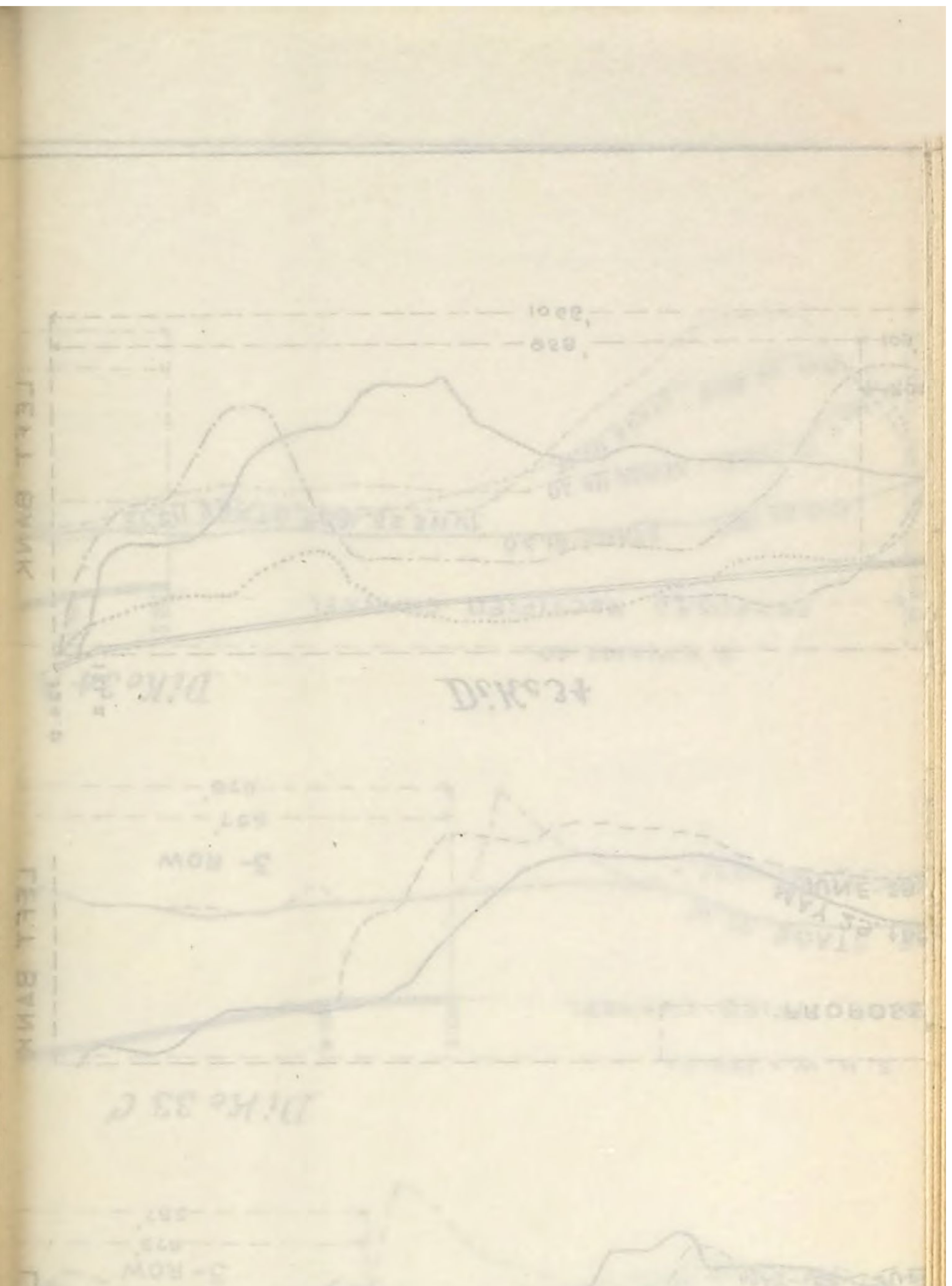
" " " " " 33 C " " " " " "

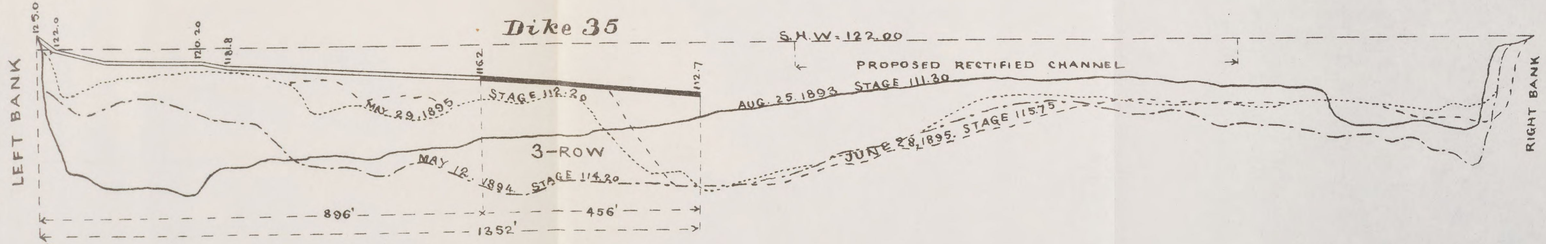
Dikes 34 and 34 A are shown on cross sections sounded between Dikes 34 and 35

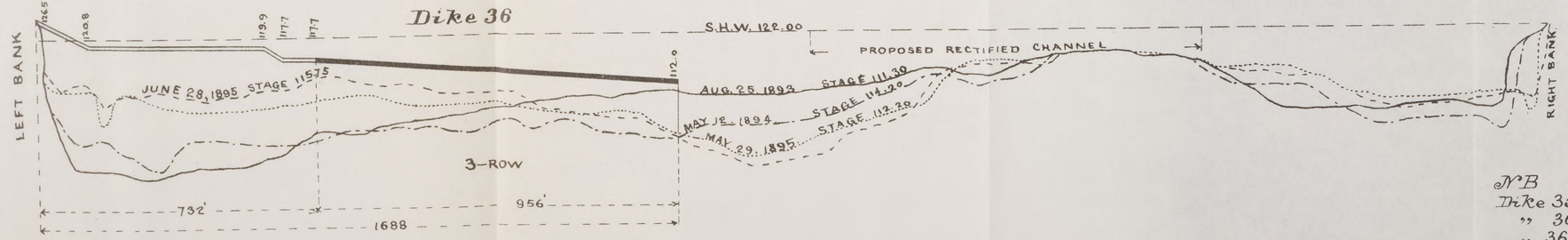
Dikes constructed prior to fiscal year of 1895 shown thus ═══

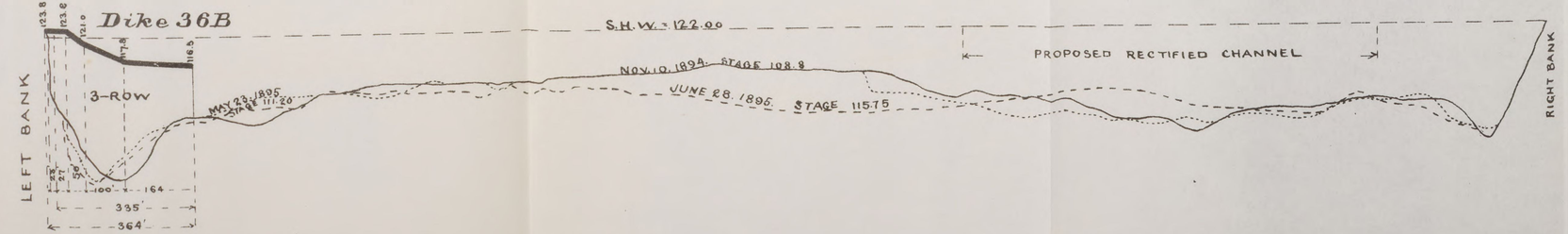
" " during " " " " " " ———

To accompany Annual Report for 1895 of Sam'l H. Yonge, Div. Engr.









MISSOURI RIVER COMMISSION,

OSAGE DIVISION, FIRST REACH.

Profiles of Dikes and Cross-Sections of River.

Scales:

HORIZONTAL 100 0 500 Feet.

VERTICAL 10 0 40 Feet.

NB

Dike 35 is shown on cross sections sounded between Dikes 35 and 36.

" 36 " " " " " " " 36 " 36B

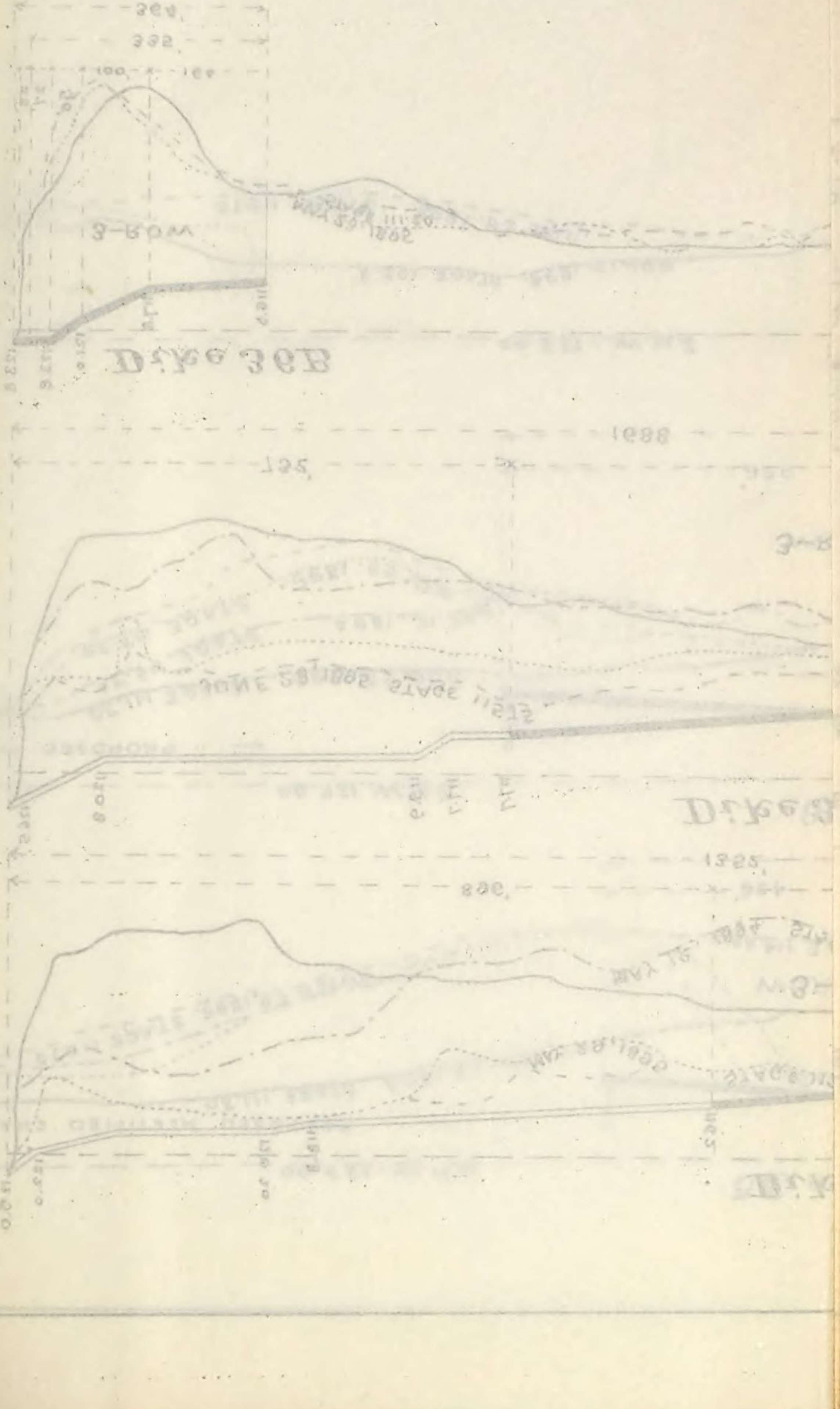
" 36B " " " " " " 800 feet below the dike.

" constructed prior to fiscal year of 1895 shown thus ═══

" " during " " " " " " " ━━━

To accompany annual report for 1895, of Sam'l H. Yonge, Div. Eng'r.

Eng 54 1



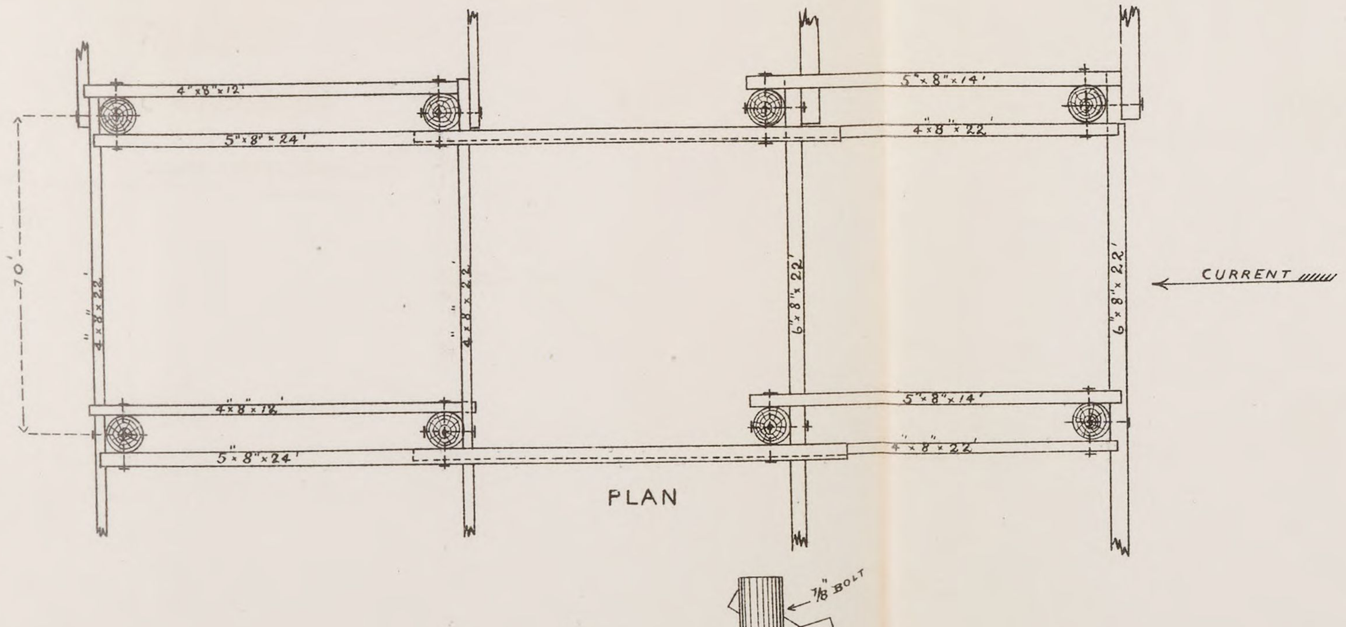
MISSOURI RIVER COMMISSION

OSAGE DIVISION FIRST REACH.

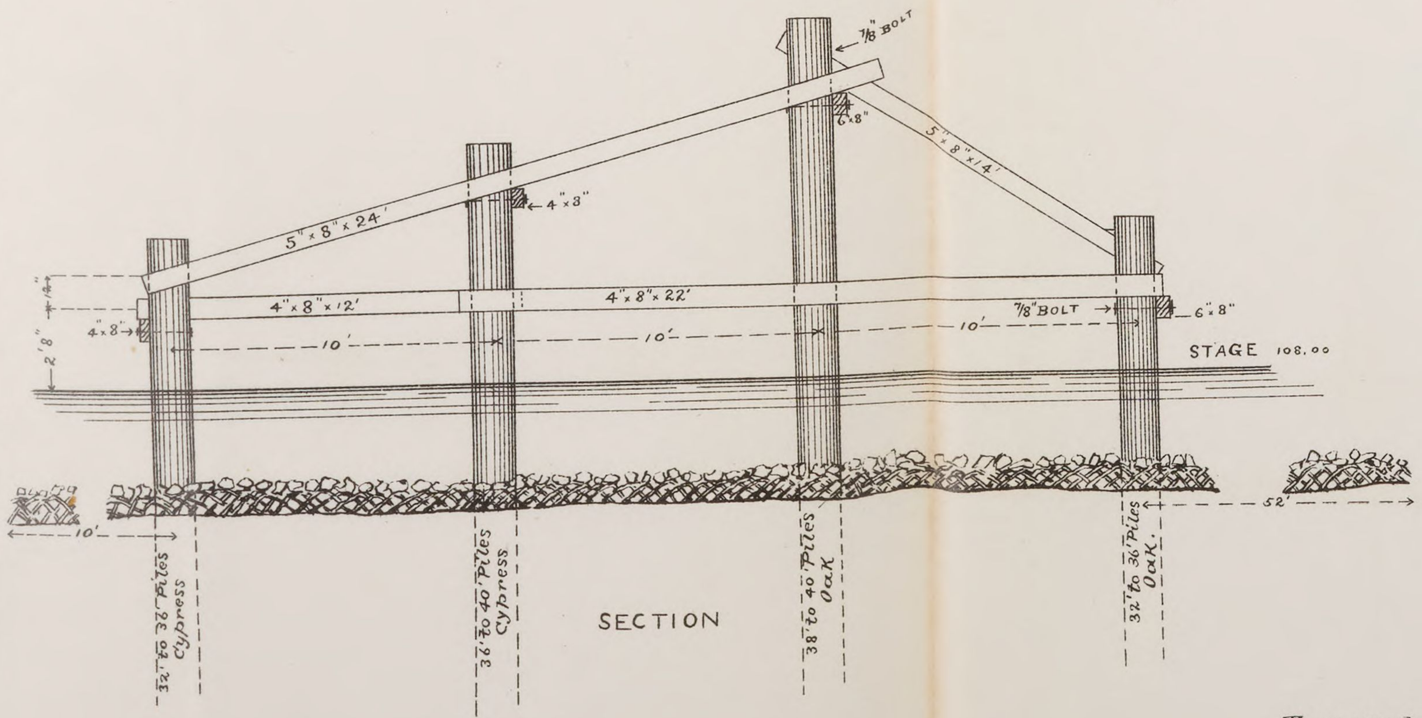
Details of bracing Dike 30.

Scale

10 5 0 10 Feet.



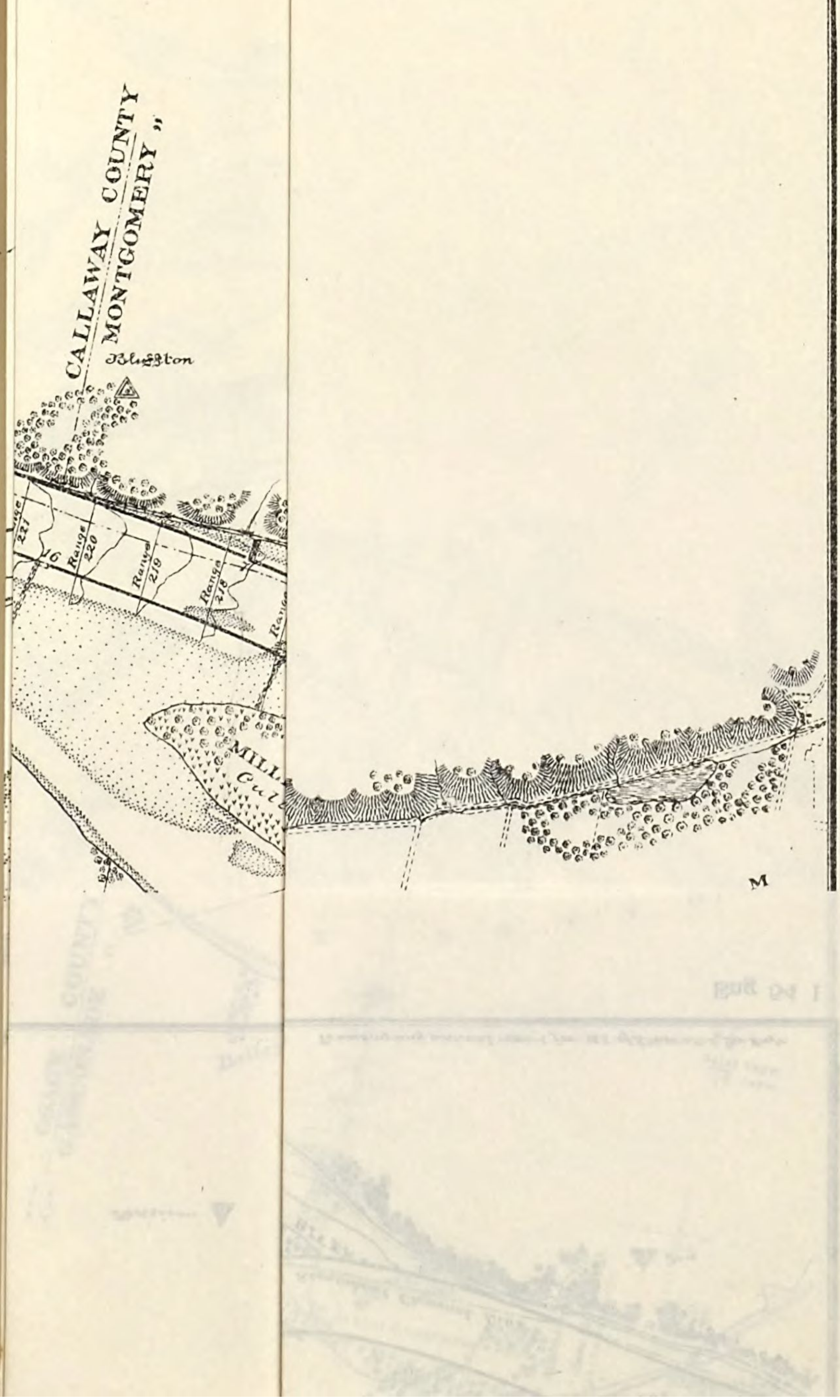
PLAN



SECTION

To accompany Annual Report for 1895, of Sam'l H. Yonge, Div. Engr.

PLATE I


CALLAWAY COUNTY
MONTGOMERY "
Bluffton
Range 221
Range 220
Range 219
Range 218
MILL
Cul
M

Missouri River Commission

Gasconade Division

Cross-Sections of River

Showing effects of Dykes

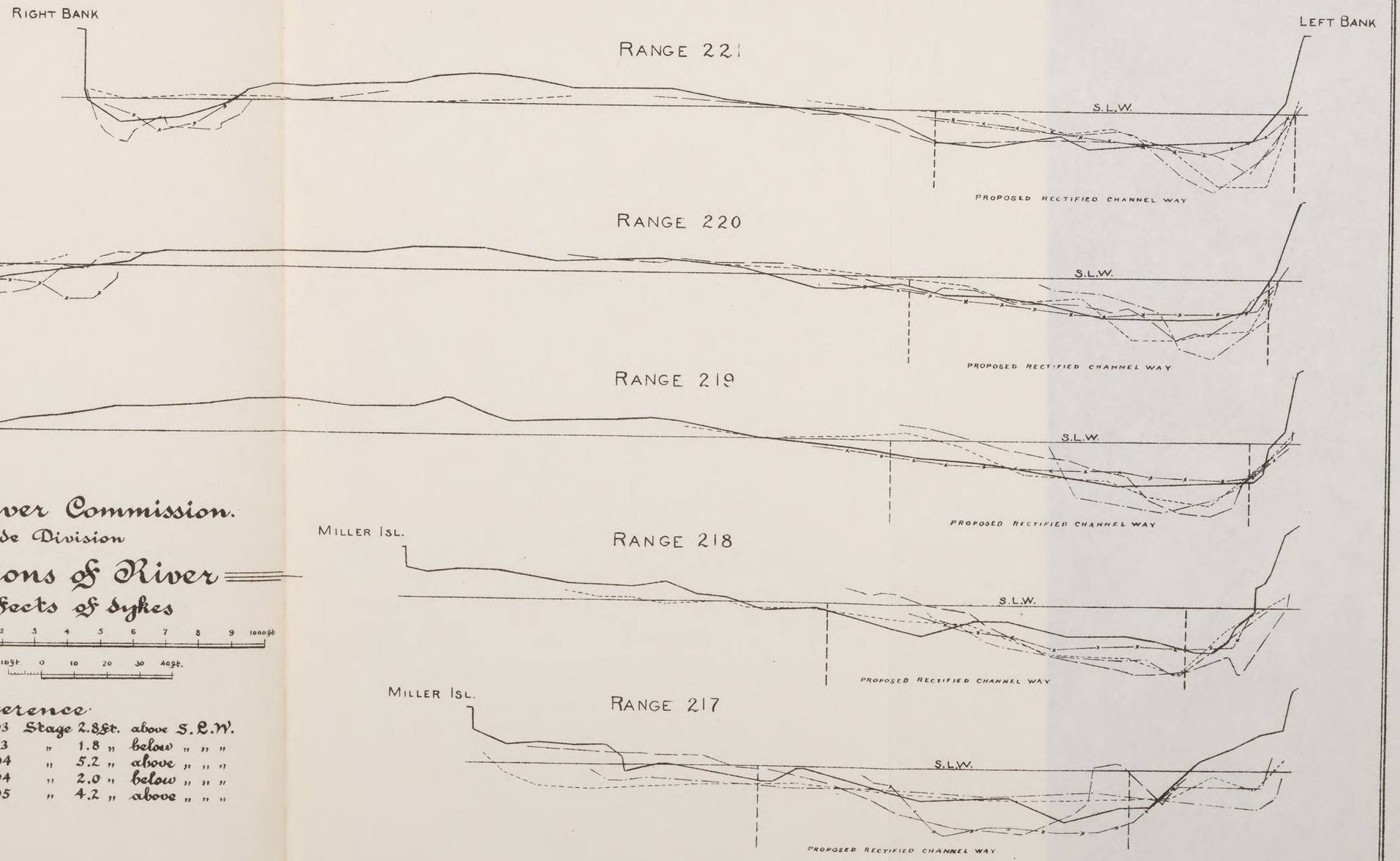
Horizontal Scale 100 Ft. 0 1 2 3 4 5 6 7 8 9 1000 Ft.

Vertical Scale 10 Ft. 0 10 20 30 40 Ft.

Reference

----------	Apl. 1893	Stage	2.8 Ft.	above	S.L.W.
—·—·—·—	Nov. 1893	"	1.8 "	below	" " "
—— —— ——	Apl. 1894	"	5.0 "	above	" " "
—x—x—x—	Nov. 1894	"	2.0 "	below	" " "
————	May 1895	"	4.2 "	above	" " "

To accompany annual report for 1895 of S. Waters For. Divn. Engrs.



Missouri River Commission.

Gasconade Division

Cross-Sections of River

Showing effects of Dykes

Horizontal Scale 100ft. 0 1 2 3 4 5 6 7 8 9 1000ft

Vertical Scale 10ft. 0 10 20 30 40ft.

Reference

Apl. 1893	Stage	2.8	ft.	above	S.L.W.
Nov. 1893	"	1.8	"	below	" " "
Apl. 1894	"	5.2	"	above	" " "
Nov. 1894	"	2.0	"	below	" " "
May 1895	"	4.2	"	above	" " "

To accompany annual report for 1895 of S. Waters Fox, Div. Engr.







Missouri River Commission.

Gasconade Division

Cross-Sections of River

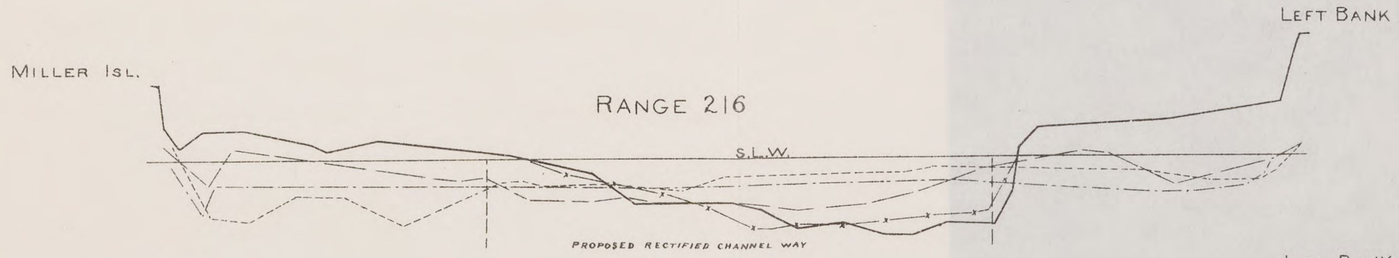
Showing effects of Dykes

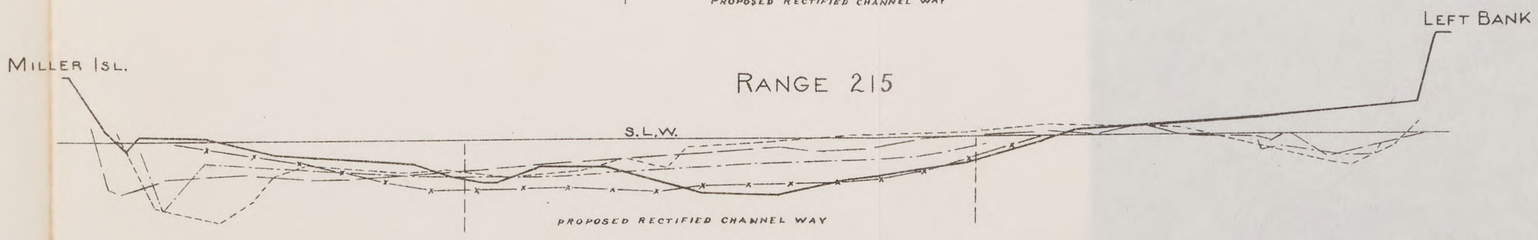
Horizontal Scale 100ft. 0 1 2 3 4 5 6 7 8 9 1000ft.

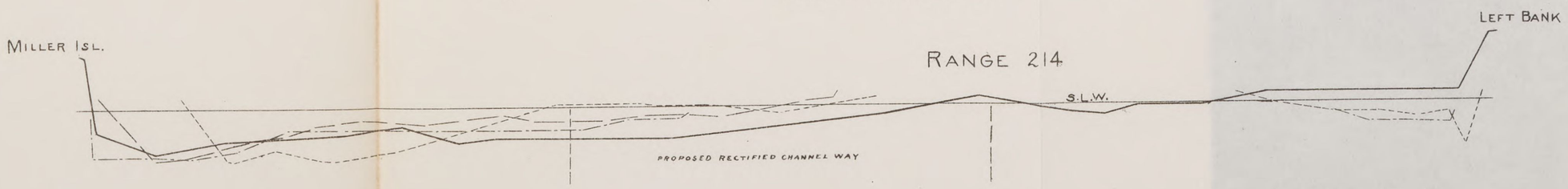
Vertical Scale 10ft. 0 10 20 30 40ft.

Reference

- Apl. 1893 Stage 2.8ft. above S.L.W.
- Nov. 1893 " 1.8 " below " " "
- Apl. 1894 " 5.2 " above " " "
- Nov. 1894 " 2.0 " below " " "
- Apl. 1895 " 4.2 " above " " "

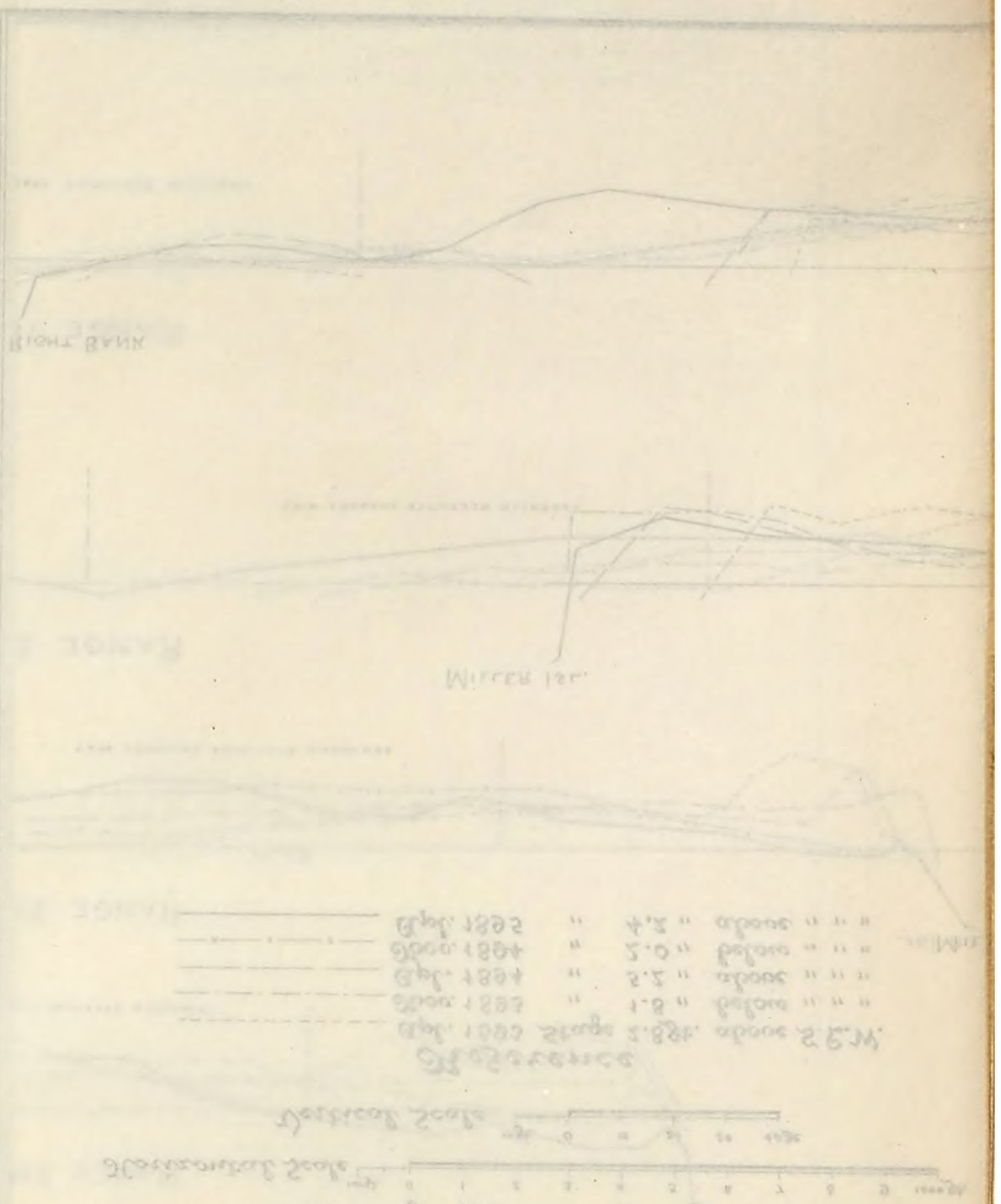






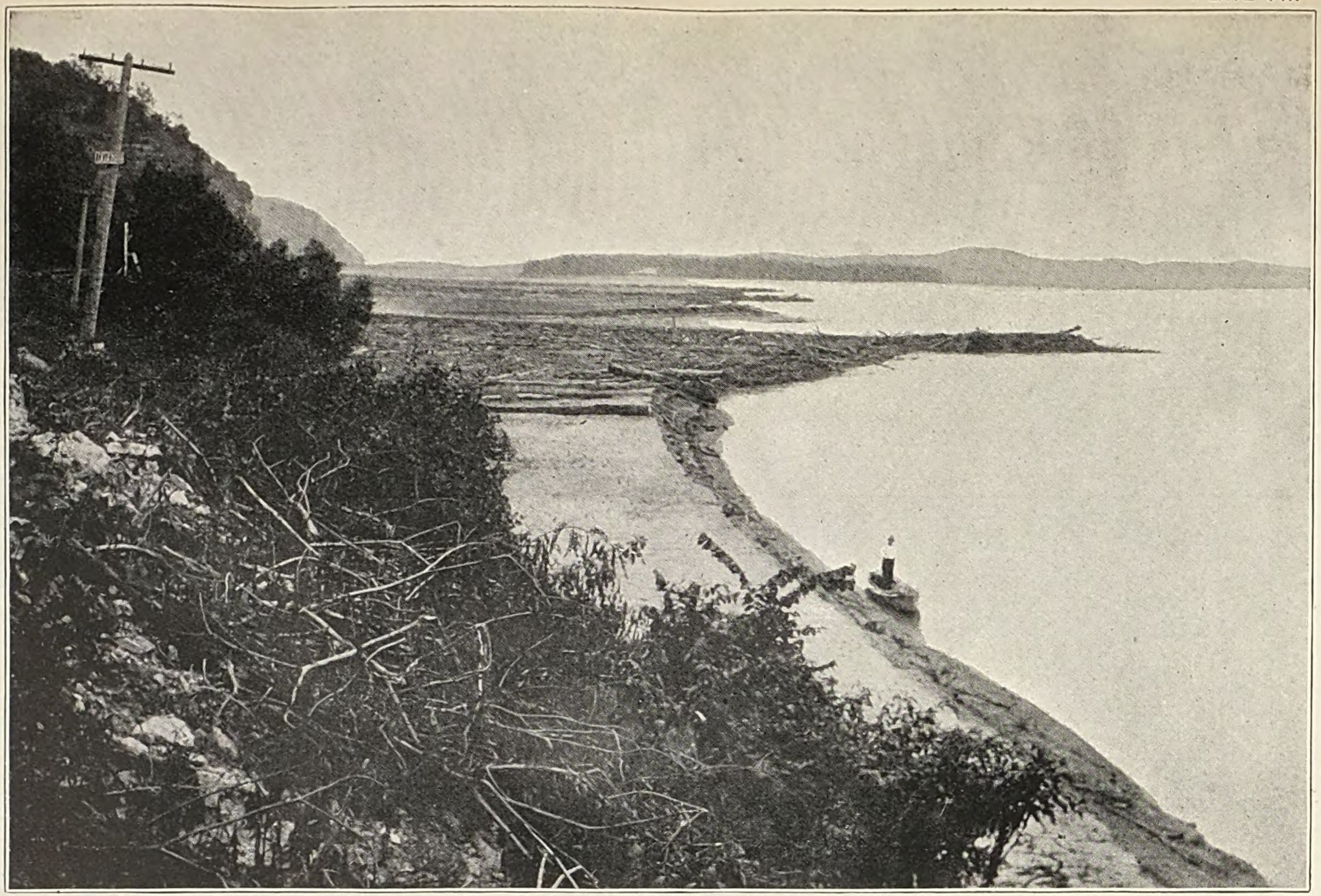


To accompany annual report for 1895 of S. Waters Fox, Div'n. Eng'rs.


RIGHT BANK
MIDDLE LAT.



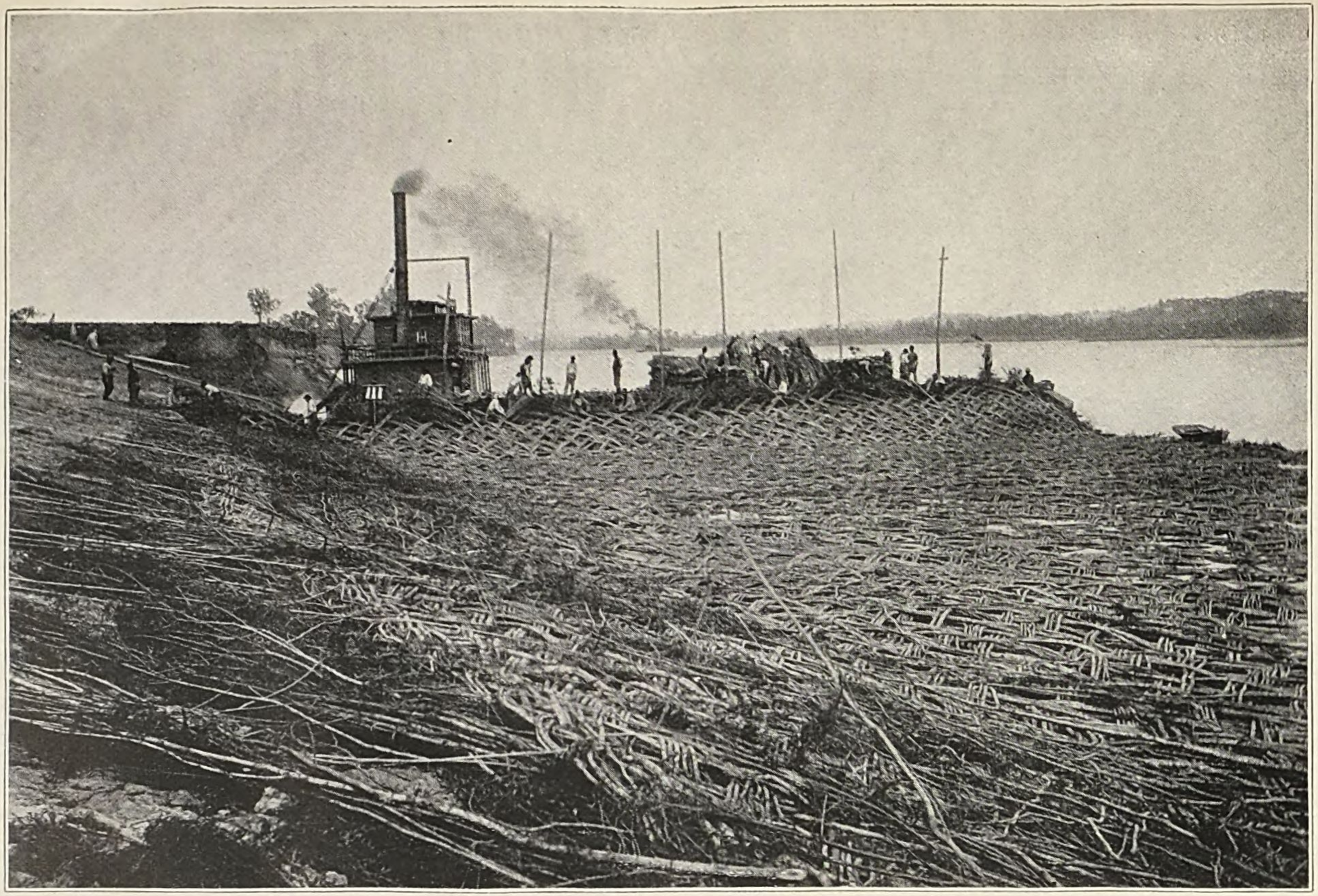
VIEW TAKEN AUGUST, 1894, SHOWING ACCRETIONS FORMED BY THE LITTLE TAVERN SYSTEM OF DIKES (Nos. I, III, AND V), CONSTRUCTED IN THE FALL OF 1893. LOOKING DOWNSTREAM.



VIEW TAKEN AUGUST, 1894, SHOWING ACCRETIONS FORMED BY THE BLUFFTON SYSTEM OF DIKES (Nos. VII, IX, XI, XIII, AND XV), CONSTRUCTED IN THE FALL OF 1893. LOOKING DOWNSTREAM.



VIEW TAKEN APRIL 11, 1895, SHOWING BALLASTING PARTY AT WORK ON SECTION No. 104, CHAMOIS BEND, PLACING ROCK BALLAST ON UPPER BANK. LOOKING DOWNSTREAM.



VIEW TAKEN JUNE 1, 1895, SHOWING MATTRESS CONSTRUCTION PARTY AT WORK ON SECTION No. 111, IN ST. AUBERT BEND. LOOKING DOWNSTREAM.



VIEW TAKEN JUNE 22, 1895, SHOWING MATTRESS CONSTRUCTION PARTY AT WORK ON SECTION No. 9, ST. AUBERT ISLAND. LOOKING DOWNSTREAM.



VIEW SHOWING STATUS OF WORK (INCOMPLETE UPPER BANK PROTECTION) IN ST. AUBERT BEND ON JULY 1, 1895. LOOKING UPSTREAM FROM LOWER END OF REVETMENT.

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APPENDIX Y Y.

ANNUAL REPORT OF THE CALIFORNIA DÉBRIS COMMISSION FOR 1894.

[Printed in House Ex. Doc. No. 11, Fifty-third Congress, third session.]

OFFICE OF THE CHIEF OF ENGINEERS,
UNITED STATES ARMY,
Washington, D. C., December 1, 1894.

SIR: I have the honor to submit the accompanying report, dated the 15th instant, of the California Débris Commission, created by the act of Congress approved March 1, 1893, entitled "An Act to create the California Débris Commission and regulate hydraulic mining in the State of California."

This is the second annual report of the Commissioners, and is made conformably to the provisions of section 7 of the aforesaid act, which requires—

> That said Commission shall submit to the Chief of Engineers, for the information of the Secretary of War, on or before the fifteenth day of November of each year, a report of its labors and transactions, with plans for the construction, completion, and preservation of the public works outlined in this act, together with estimates of the cost thereof, stating what amounts can be profitably expended thereon each year. The Secretary of War shall thereupon submit same to Congress on or before the meeting thereof.

Very respectfully, your obedient servant,

THOS. LINCOLN CASEY,
Brig. Gen., Chief of Engineers.

Hon. DANIEL S. LAMONT,
Secretary of War.

ANNUAL REPORT OF THE CALIFORNIA DÉBRIS COMMISSION FOR 1894.

OFFICE OF THE CALIFORNIA DÉBRIS COMMISSION,
San Francisco, Cal., November 15, 1894.

GENERAL: The California Débris Commission has the honor to submit the following, its second annual report:

The Commission was created by act of Congress approved March 1, 1893. Its members are Col. G. H. Mendell, Corps of Engineers, president; Lieut. Col. W. H. H. Benyaurd, Corps of Engineers; Maj. W. H. Heuer, Corps of Engineers, secretary.

First Lieut. Cassius E. Gillette, Corps of Engineers, has been on duty with the Commission throughout the year as executive and disbursing officer and in charge of office and records. The State débris commissioner, the Hon. John F. Kidder, has been present at most of the sessions of the Commission, and has accompanied its members in visiting hydraulic mines.

The jurisdiction of the Commission extends to hydraulic mining in the territory drained by the Sacramento and San Joaquin river systems in California.

The duties of the Commission may be briefly summed up to be: First, the prevention of such hydraulic mining as may be deemed injurious to the navigable waters within the Commission's jurisdiction; permitting, under proper regulation, such mining in cases where it can be carried on without such injury; second, to mature general plans for the improvement of the rivers whose navigability has been injured by hydraulic mining and, if practicable, to devise general methods whereby such mining may be carried on without damage to the navigable waters.

The history of hydraulic mining, as affecting the navigable waters above referred to, may be summed up as follows:

The rapid washing of the large deposits of auriferous gravel, on the western slope of the Sierra Nevada Mountains, by the so-called hydraulic process, resulted in the discharging into the canyons of large quantities of gravel, sand, and other detritus, which the floods subsequently carried down, to be at first deposited largely where the streams emerged from the foothills into the level plains of the Sacramento Valley, afterwards to be moved farther down to the navigable streams and the finer portions even to tide water. The result was that near the foothills the beds of some of the streams filled up much more rapidly than their banks rose, so that their channels largely disappeared, and at flood time the streams spread over the valley lands, frequently destroying their value by covering the rich alluvium with gravel, sand, etc., often several feet deep. Long and high levees were built by the landowners to prevent as much as possible such damage. The finer particles brought down by the streams were carried into the navigable rivers, filling up the deep pools, and in general changing the character of the bed from a succession of pools and shoals to a continuous shoal. The capacities of the streams to discharge their flood waters without overflowing their banks were reduced. Legal action brought against the mine operators by persons owning damaged lands, and by the United States in the interests of navigation, resulted in injunctions against the principal mines and ultimately in the practical suppression of hydraulic mining in the region under consideration. Subsequently Congress created the Commission with the duties as heretofore outlined. (For a detailed history of the effects of hydraulic mining reference is made to House Ex. Doc. No. 98, Forty-seventh Congress, first session; also House Ex. Doc. No. 267, Fifty-first Congress, second session; and to the last annual report of the Commission.)

PREVENTION OF ILLEGAL MINING.

The Commission, under date of April 4, 1894, applied to the Secretary of War for instructions as to the intent of the law in reference to hydraulic mining carried on without permits from the Commission. The opinion of the Attorney-General is appended, and marked A. In accordance therewith the Commission has given the owners of eight mines notice to cease mining. None of them have failed to obey the orders, and four of them have since made application to the Commission for permits. These mines are all small.

The North Bloomfield Gravel Mining Company, which has been operating its mine under a decision of the United States circuit court for this district, although notified, has not applied for a permit to use the hydraulic process. The facts in the case have been referred to the Chief of Engineers.

APPLICATIONS AND PERMITS.

The Commission since it organized has received eighty applications to mine, of which number fifty-two have been given permits. A table showing a synopsis of the applications received and the action taken is appended, and marked B.

The total amount of material mined under permits from October 1, 1893, to October 1, 1894, is estimated at 1,500,000 cubic yards. The available storage provided at present, and partially and wholly completed, for future operations, is estimated at 8,500,000 cubic yards. Comparing these figures with 38,000,000 cubic yards, estimated to have been mined in 1880, and the estimated amount of several hundred million cubic yards available to be worked, it will be seen that the system provides for the present working of only a small percentage of that possible under unrestricted mining. However, there are undoubtedly many mines which have not yet made application to the Commission, for which there is available storage as feasible as that prescribed by the Commission for other mines that are working under permits.

The requirements in respect to storage of detritus exacted by the Commission vary with many conditions. Among these may be mentioned the character of the material; the river the detritus reaches; the size of the mine; its distance from navigable rivers; the output of other mines in the same drainage basin; the quantity of water flowing in that basin, and its other physical features; and the drainage through the dam site itself. If the latter is an old hydraulic pit, or a so-called flat, or a dry ravine, in which the natural flow of water is at all times very small, any type of dam that will endure while mining is carried on is considered to be efficient. In all other cases dams of a more permanent nature are required. In a small stream a gravel dam of such a height, with a spillway in rock of such a size that no water can ever go over the crest of the dam, is taken as permanent. A brush or timber dam is not considered permanent except where so situated as to be always kept wet, and such dams have in general been approved for small mines only, located at great distances from navigable streams, or on streams on which the total amount of mining is small. The Commission has not as yet issued a permit for hydraulic mining in a case where the detritus is to be stored in the beds of the larger affluents of the main rivers.

The effects of freshets upon barriers in their path and in removing material stored behind barriers, even when the latter are maintained and uninjured, can be estimated best, and with least danger, in small streams. Success in these instances may justify storage in larger water courses.

The Commission is feeling its way, by the light of experience, to a course of final action which shall give the greatest freedom to mining that may be found to be consistent with a due regard to other great interests intrusted to its charge.

The sources of information open to the Commission are the monthly reports required of each miner holding a permit; the inspections and reports of its executive officer, and those of a civil assistant, Mr. W. B. Storey, jr., who has been employed during the working season in visiting and overseeing mining operations in Plumas and Nevada counties.

These inspections and reports relate to the effectiveness of restraint of detritus, and include observations of the quantities of material escaping to the water courses. A system of observation has been developed by the use of the hydrometer, which gives in a ready manner that proportion of escaping material that can, for the purposes

concerned, be regarded as soluble. This refers to the clays or to sand in exceedingly minute grains. This character of material can be stored only in cases where a period of rest can be secured behind barriers. The period of stagnation is rarely sufficient to absolutely precipitate all suspended material. To require this would in most cases be equivalent to suppression of hydraulic mining. It is the endeavor of the Commission in each case to reduce the escape to a minimum, and each case has its own solution. The Commission has not as yet adopted a minimum admissible proportion of escape which shall be applicable to all cases. Whether or not such a rule of general application shall finally be adopted is as yet uncertain. If so, it will result from a more extended experience and multiplied observations.

The rivers most seriously affected by mining detritus are the Yuba and Bear. The mass of material in the lower end of the Yuba, from where it leaves the foothills to its mouth at Marysville, is so great that the present river bed is several feet above the surrounding country. It is confined by levees from 8 to 15 feet high, placed about 2 miles apart. The mass of detritus at its mouth forms a kind of submerged dam in the Feather River, so that at each high water the city of Marysville, though surrounded by high and strong levees, is seriously threatened with great danger, or even destruction. The navigability of the Feather River below the mouth of the Yuba is much impaired by this filling. Conditions similar to those of the Yuba obtain to a less degree on the Bear, another and smaller tributary of the Feather.

Under these conditions a more thorough impounding of detritus is required by the Commission for mines draining into these rivers than those situated on other streams where matters are in a less serious condition. Thus somewhat less rigorous exactions are required on the American and Feather rivers and still less on the tributaries of the San Joaquin.

The case of each mine has been decided on its own merits, after careful examination by the Commission, or a committee of its members.

IMPROVEMENT OF RIVERS.

As to the second part of the Commission's duties, the maturing of general plans for the improvement of rivers, in connection with the possible permission of hydraulic mining, the Commission has given the subject consideration, but owing to the fact that the funds available have been deemed necessary for the expenses incident to the first part of its duties, the Commission has not undertaken the surveys, which would be necessary before formulating definite plans of such scope as outlined by section 4 of the act of March 1, 1893.

The Commission is in possession of numerous maps, reports of examinations, etc., and a large amount of testimony in legal cases, affecting hydraulic mines; yet a great deal of the latter is such that, before the Commission could make definite recommendations on the general subject, much of this information would have to be checked by surveys and examinations. For example, the most elaborate estimate of the quantity of hydraulic material already mined on the Yuba and its tributaries, is that given by the testimony of the engineers for the plaintiff in the case of Woodruff *v.* North Bloomfield Mining Company, which total amount is set at 176,000,000 cubic yards. It is not probable that the witnesses in this case would underestimate, and yet the most reliable estimate of the amount of such material now in the Yuba, from De Guerre Point to Marysville, is 308,000,000 cubic yards. This latter estimate is based on a Government survey of the topography and a series of 35 borings through hydraulic material, the average depth of

which was found to be 16 feet. A rough estimate of the quantity of this material between Smartsville and De Guerre Point, estimating its average depth to be 30 feet, is about 100,000,000 cubic yards, making a total of 408,000,000 cubic yards now in this part of the river, as the result of the mining of 176,000,000 cubic yards. This material is nearly all the result of hydraulic mining and not of natural wash.

When the large amount of material that has gone into the Feather River, and the amounts still left in the smaller canyons and on the dumps are taken into consideration, the discrepancy becomes too enormous for much reliance to be placed upon existing estimates of material mined, or to be mined, and reliable estimates are essential before the Commission can formulate any useful plans concerning it.

As to the rivers themselves, surveys were made by the United States and the State of California in 1878, but no reliable or extensive surveys have been made before or since, from which comparative results could be obtained. A survey of the Sacramento and Feather rivers is now being made by Maj. W. H. Heuer, the officer in charge of these rivers, and it is also understood that the State board of public works is making surveys of tule lands, etc., in the Sacramento Valley, the result of which surveys will be available and useful to the Commission, but beyond these, further extensive examinations and surveys will be needed before the Commission can make reliable plans of the nature required.

The Commission has examined, to some extent, the condition of the Sacramento River, and of Suisun Bay, into which it empties, with reference to the changes of the bottom since the beginning of hydraulic mining. Taking Suisun Bay, the earliest Coast Survey chart (Ringgold's map, made in 1850) gives its total area as 199,327,000 square yards. The last Coast Survey chart published (survey of 1878, most of the hydrography made in 1866) gives the bay a superficial area of 160,882,000 square yards. Comparison of similar cross sections, taken every half mile over this territory, gives the following average depths: 1850, 14.05 feet; 1878, 7.92 feet; average fill 6.13 feet, showing that nearly one-half the original volume of water in the bay was replaced by sediment between 1850 and 1878. It is understood that a complete survey of this bay was made in 1885 by the United States Coast and Geodetic Survey, but the results, excepting a small territory about the mouth of the Sacramento River, have not as yet been published. The part published indicates a fill of 1.6 feet near the mouth of the river since 1878. When the chart of the whole bay is published it should give valuable results. Taking the above figures as reliable, there were deposited in Suisun Bay, between 1850 and 1878, 407,000,000 cubic yards. Assuming that the fill since 1878 has been at the same rate for the whole bay as that shown at the mouth of the river, the indications are that the rate of deposit in the bay was about 10,000,000 cubic yards per year from 1878 to 1885.

As to the quantity of material now in the Feather and Sacramento rivers below Marysville the following may be said: The area of the two rivers between Marysville, the mouth of the Yuba, and Collinsville, the mouth of the Sacramento, is estimated to be, at low water, 38,000,000 square yards; at high water, between the levees, 48,000,000 square yards. Estimates and observations, more or less reliable, indicate that the average raising of the river bottom at Sacramento since 1850 has been at least 15 feet, and not less than that at Marysville. The average fill at Collinsville at the same time is about 5 feet. Assuming the mean fill to be 9 feet for an area of 40,000,000 square yards (something greater

than the low-water area), we have 120,000,000 cubic yards now in the Sacramento and Feather rivers below Marysville.

These figures, while more or less approximate, indicate that the possible filling up of Suisun Bay and the consequent removal of the mouth of the Sacramento and San Joaquin rivers from near Collinsville to near Benicia are questions that must be given serious attention before definite plans for the cleaning out of the rivers, etc., be formulated.

It is estimated that $20,000 will be necessary for surveys, etc., before the Commission can carry out the second part of its duties.

THE RETENTION OF DETRITUS NOW IN THE YUBA RIVER.

The Commission has recently made a careful examination of the Yuba River between De Guerre Point and Marysville, and has noted the changes brought about, either by natural or artificial action, in recent years.

A member of the Commission has charge of the improvement of the Sacramento and Feather rivers. Surveys have been made on the Yuba under his direction within the past two years.

All reports upon the improvement of the Sacramento and Feather rivers have maintained that no great betterment in navigation is to be expected so long as an enormous output of sand is yearly delivered to these rivers, and restraint of this detritus in the foothills or plains has been therein advocated.

From a consideration of these data the Commission has arrived at the conclusion hereinafter stated.

The act of March 1, 1893, adopts the recommendations contained in House Ex. Doc No. 267, Fifty-first Congress, second session, and in House Ex. Doc. No. 98, Forty-seventh Congress, first session, so far as they relate to impounding dams and other restraining works, and directs that the same be made the basis of the operations of this Commission. Among the recommendations made in these reports is a restraining barrier in the Yuba River at De Guerre Point, the purpose of which is the retention above it of a mass of stones, gravel, and sand, produced by mining in past years, which is moving downstream, and which to a large extent each year reaches navigable waters.

In the last annual report the Commission recommended an appropriation for this structure. It was not recommended for the purpose of permitting deposit of additional detritus from mines in the Yuba River bed, but merely for the impoundment of the detritus already lying in the foothills exposed to the action of freshets.

In 1891 a Board of Engineers made a report upon the improvement of the Sacramento and Feather rivers, which is printed in the Report of the Chief of Engineers for that year, on page 2990 et seq. This report, after describing the deposits of sand and gravel lying in the Yuba above Marysville, considers the treatment best adapted to the existing conditions, and recommends that the Yuba, beginning at De Guerre Point, be trained and controlled in one channel, by protection of its banks, mainly by brush work. This Commission accepts and indorses this recommendation.

The Government has done little or nothing so far in carrying out this recommendation.

The levee commissioners of the Marysville district, however, found it necessary for the protection of their levees to divert and partially control the river. These operations, so far as carried, have been successful, and now the Yuba below De Guerre Point is for the most part controlled in one channel. Where this channel lies between wooded banks the bed has the appearance of permanence. For some part of

the way the banks are of clean sand, and here the control is imperfect and probably temporary.

The purpose and end of the engineering operations necessary to effect control are to raise the said banks to the height at which the willows will take root and grow. As soon as the thicket of willows becomes established they seem to protect the bank.

The Commission is informed that there remains available part of an appropriation for the Sacramento and Feather rivers that can be applied to this work, and for that reason no estimate is now submitted for the purpose.

When this result shall have been secured the large deposits of detritus lying below De Guerre Point, estimated to contain several hundred millions of cubic yards, may be regarded as impounded. Indeed, a large part, if not the greater part, has been already stored by the natural growth of willows, covering the portions which lie highest and above the level of the ordinary freshet. The lowering of the river bed, which results from its confinement to one channel, lowers the freshet level and favors the growth of willows.

If the expected results shall be obtained below De Guerre Point, the next object to be attained is the storage of the mass of material lying above De Guerre Point, either by a similar treatment of the river or by storage behind one or more impounding barriers.

When these operations shall have been carried out the degree of impoundment that is practicable will have been secured, and the contribution of detritus to navigable channels will be reduced to a minimum.

In the process of reaching this betterment the bed of the river is lowered by scour, and the material thus set loose must be carried below, and to a greater or less extent must reach navigable waters; but the masses of detritus on either side will year by year be less a source of danger.

The quantity of material brought down by the Yuba can not be estimated with any approach to accuracy. It doubtless varies from year to year with the height and duration of freshets. Nor is it possible to trace this material, except in part, by its places of temporary or permanent deposit. There is evidence, however, that the annual quantity is very large, so large that no great betterment of navigation on the Feather can be expected until a great reduction in the amount shall be established.

In illustration it may be stated that the new deposit in the old river bed of the Yuba at its mouth, where a new channel was cut a year ago, is estimated by the engineer officer in charge to be between 400,000 and 500,000 cubic yards. What proportion this bears to the whole is unknown.

During the coming year the Commission hopes to make recommendations for restraint of detritus lying in the Bear and American rivers.

Money statement.

Balance available from last appropriation	$8,950.02
Estimated necessary for surveys, etc	20,000.00

esgectfully submitted.

G. H. MENDELL,
Colonel, Corps of Engineers.
W. H. H. BENYAURD,
Lieut. Col., Corps of Engineers.
W. H. HEUER,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers U. S. A.

APPENDIX A.

LETTER OF THE ATTORNEY-GENERAL OF THE UNITED STATES.

DEPARTMENT OF JUSTICE,
Washington, D. C., April 24, 1894.

SIR: Your letter of 18th instant states that the California Débris Commission, created by act of Congress (27 Stat., 507), reports that the Volcano Gold Gravel Mining Company (a corporation) is mining by the hydraulic process in California, within the territory of the jurisdiction of the Commission, as defined by the act; that a portion of the "detritus" from this mining must reach the Sacramento River and do more or less injury to the navigability of this stream; that the company have not made application to mine, nor has it made the surrender referred to in section 10 of the act.

On this state of fact you submit for my opinion the following inquiries:

1. As to the application to this case of the last sentence of section 19 of the act creating the Commission.

The sentence indicated is as follows:

"Said Commission shall take necessary steps to enforce its orders in case of the failure, neglect, or refusal of such owner or owners, company or corporation, or agents thereof, to comply therewith, or in the event of any person or persons, company or corporation, working by said process in said territory contrary to law."

Section 19 applies to those mine owners who have filed the petition provided for in section 9 and have surrendered to the United States the right to regulate the working of the mine, as provided for in section 10. But it also extends to all who have not complied with sections 9 and 10, but who are "working by said process in said territory contrary to law."

Section 3 provides that "hydraulic mining, as defined in section 8 thereof, directly or indirectly injuring the navigability of said river systems, carried on in said territory, other than is permitted under the provisions of this act, *is hereby prohibited and declared unlawful.*"

So the Commission has the power to take such "necessary steps" as may be required to prevent or restrain those persons who, by the operations of hydraulic mining, are injuring the navigability of the river in the defined territory.

2. Whether or not it is the duty of the Commission to give the company orders to cease hydraulic mining.

While it may not be strictly the legal duty of the Commission to give such orders, it would seem to be on all accounts preferable that, before resorting to the harsh and drastic remedies of the law, the attention of the offending company should be called to the provisions of the statute and to the acts and conduct of the company, which appear to be in violation of those provisions, to the end that the evil complained of may be voluntarily removed and the company admonished of the consequence of continued recusancy.

3 and 4. If the second question be answered in the affirmative, what course the Commission shall pursue to enforce such order, and what steps should be taken to enforce the provisions of the act.

The obvious remedy would seem to be by injunction, to be obtained from one of the judges of the Federal courts in California, on a bill in equity, brought in the name of the United States by the district attorney.

This appears to have proven efficient in the cases of The People of the State of California *v.* The Gold River Ditch Company (66 Cal., 138), on a state of facts nearly resembling that above stated, and in Willamette Iron Bridge Company *v.* Hatch (125 U. S., 1), where like principles were involved.

Very respectfully,

RICHARD OLNEY,
Attorney-General.

The SECRETARY OF WAR.

APPENDIX B.

Synopsis of applications for authority to mine, with action taken thereon.

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—	Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to Oct. 1, 1894.	Storage capacity yet available partly or wholly completed.
						Cubic yds.	1893.			*Cubic yds.*	*Cubic yds.*
1	Kelly Hill	Butte.....	R. M. Mooer.....	Sacramento ...	Rock dam 30 feet high in dry ravine, side spillway cut in rock.	1,000,000	Aug. 2	Sept. 9, 1893	Mar. 27, 1894	9,000	41,000
2	Farrell	Nevada.....	Eureka Lake and Yuba Canal Co., Consolidated.	Middle Yuba..	Dam 12 feet high of earth and logs across mouth of old hydraulic pit.	212,000	Aug. 11	Works already built.	Sept. 8, 1893	66,000	150,000
3	Omega.....	.....do	N. C. Tully	South Yuba...	Dam 80 feet high in Scotchman Creek, of brush and gravel, side spillway cut in rock.	2,160,000	Aug. 16	Sept. 9, 1893	.....	.....	1,000,000
4	Brandy City..	Sierra.....	A. Steinberger....	Middle Yuba..	Brush and earth dam across mouth old hydraulic pit.	1,520,000	Sept. 19	Oct. 25, 1893	Oct. 9, 1894	.....	1,940,000
5	Blue Nose....	Plumas	B. Below.....	Middle Feather	Stone dam, Hopkins Creek..	50,000	....do ...	.....	.....	.....	50,000
6	Blue Gravel..	Yuba.....	Excelsior Water and Mining Co.	Yuba.....	Old hydraulic pit, with tunnels stopped with rock.	604,000	Sept. 27	Works already built.	Oct. 17, 1893	371,614	2,500,000
7	Illinois Gold Gravel.	Plumas	H. Backley and Louis L. Hillman.	.....do.....	.....do	35,000	Sept. 29	Jan. 4, 1894	Jan. 31, 1894	4,351	470,649
8	New York Gold Gravel.	Sierra.....	Westall & Hughes.	South Yuba...	Brush, log, and earth dam, Howard Creek, spillway in rock.	484,000	Oct. 12	Nov. 21, 1893	Dec. 5, 1893	15,600	84,400
9	Corbiere & Bean.	Butte.....	Corbiere & Bean..	North Yuba...	Rock dam 10 feet high in Hampshire Creek.	2,000	Oct. 9	Works already built.	Nov. 21, 1893	3,000	7,000
10	Phœnix Gold Gravel.	Sierra.....	W. A. & M. E. Schofield.	.....do.....	Dams Whisky Creek and North Fork of Slate Creek.	1,660,000	Oct. 14	June 27, 1894	.....	.....	.....
11	Eureka Mining Co.	.....do	Eureka Mining Co	.....do.....	Timber dams in Saw mill Ravine.	553,000	Oct. 16	Nov. 21, 1893	May 29, 1894	12,000	3,000
12	Craycroft Mining Co.	.....do	Craycroft Mining Co.	.....do.....	Timber dams, Hughes and Davidson ravines.	140,000	....do ...	.....do	.....do	8,000	13,000
13	Excelsior Hydraulic.	.....do	Excelsior Mining Co.	....do.....	Timber dams, Eagle Gulch and Smiths Flat.	277,000	....do ...	.....do	.....do	10,000	.....
14	Spanish Ranch	Plumas	Quincy Mining and Water Co.	North Feather.	Timber dams, Spanish Creek and old hydraulic pit.	3,000,000	Oct. 18	.....	.....	.....	.....
15	Gopher Hill...	.....do	.....do	.....	.....do	2,000,000	....do ...	Dec. 6, 1893	Apr. 14, 1894	208,000	210,000

Synopsis of applications for authority to mine, with action taken thereon—Continued.

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—	Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to Oct. 1, 1894.	Storage capacity yet available partly or wholly completed.
						Cubic yds.	1893.			*Cubic yds.*	*Cubic yds.*
16	Polar Star[1]	Placer	John Spaulding	Bear	Stone and gravel dam in Little Bear River, with spillway.	605,000	Nov. 3	Works already built.	Dec. 13, 1893	12,800	.....
17	A. Denmire	Sierra	A. Denmire	North Yuba	Dams in dry ravine	17,000	Nov. 6	Dec. 13, 1893	.....	.....	20,000
18	Nevada	do	Geo. W. Cox	Yuba	Dams, North Branch Slate Creek.	10,000	Nov. 14	June 27, 1894	.....	.....	6,000
19	'Fifty-four Flat.[2]	Amador	'Fifty-four Flat Mining Co.	Mokelumne	Brush dam in ravine	15,000,000	do	Jan. 11, 1894	Feb. 6, 1894	32,446	.....
20	Red Hill	Shasta	Nathan Gardiner	Sacramento	Five dams in gulch	750,000	Nov. 16	Jan. 4, 1894	do	4,500	20,500
21	Badger	do	W. R. Stewart	Cottonwood	Flat ground	2,500	Nov. 29	No works required.	Jan. 2, 1894	35	3,000
22	First Chance	Sierra	Frank E. Barbero	North Yuba	Bowlder, log, and brush dam, Howard Creek.	200,000	Dec. 4	Works already built.	do	700	7,930
23	Tannery Ravine.	Yuba	W. R. Reed	Yuba	Log and brush dam in ravine.	9,000	do	Jan. 4, 1894	Jan. 10, 1894	60	2,000
24	Mateos	Sierra	Manuel Mateos	North Yuba	Westall & Hughes Dam, Howards Creek.	.....	do	Works already built.	Jan. 2, 1894	.....	.....
25	Davis	do	Joseph Davis	do	do	.....	do	do	do	837	.....
26	Christmas Hill.[3]	Placer	Hannah McKinstry, E. E. McKinstry, and E. B. Gilbert.	American	.....	200,000	Dec. 5	.....	.....	.....	.....
27	Walker[4]	Shasta	Olonzo Engle and Frank Walker.	Cottonwood	1 rock and 4 brush dams, Pomroy Gulch.	675,000	Dec. 8	Jan. 4, 1894	Jan. 31, 1894	1,076	.....
28	North Star[5]	Calaveras	Philip McGuire, Philip McGuire, jr., Bernard McGuire.	Mokelumne	Dams, Buckeye Gulch	500,000	Dec. 13	do	Jan. 10, 1894	31,618	.....
29	Hustler	Nevada	Joseph Hustler	South Yuba	Gravel dam, Kilroy Cut	90,000	Dec. 17	Jan. 31, 1894	Aug. 13, 1894	.....	21,000
30	Green Mountain.[6]	Calaveras	J. W. Smith	Calaveras	Old hydraulic pit with brush dam.	250,000	do	Jan. 4, 1894	Jan. 8, 1894	3,534	.....
31	Noonday	Sierra	John Egbert	North Yuba	Flat, near mine	40,000	Dec. 26	No works necessary.	Oct. 23, 1894	.....	50,000
32	Pomroy[7]	Shasta	John McGrew, Olonzo Engle.	Cottonwood	Rock dam, Pomroy Gulch	1,400,000	do	Works already built.	Jan. 31, 1894	3,737	.....
33	Union	Plumas	Daniel W. Albert.	Yuba	Rock and brush dam in French Gulch.	3,200	do	Mar. 7, 1894	Mar. 27, 1894	230	3,000
34	Welch Placer.	Sacramento.	Columbia Gold Mining Co.	Cosumnes	Stone dam	161,000	Dec. 27	Jan. 31, 1894	Feb. 10, 1894	39,368	20,000

35	French Corral.	Nevada	Kate Hayes Mining Co.	South Yuba	Old hydraulic pit	450,000	do	do	Mar. 13, 1894		
36	Manzanita	do	do	Main Yuba	do	1,169,500	do	Apr. 10, 1894	May 1, 1894	500,000	500,000
37	Campo	Yuba	Fausteno Campo	Yuba	Rock dam in gulch	1,000	Dec. 29 1894	Works already built.	Mar. 7, 1894		7,000
38	Herring Ravine.	do	J. M. Wetmore	do	Rock and brush dam mile below mine.	660	Jan. 10	do	do	300	250
39	Conduit Ravine.	do	W. W. & W. A. Lemon.	do	Rock and brush dam	10,000	Jan. 21	Mar. 7, 1894	Mar. 27, 1894		
40	Motor	do	Jas. Gordon	do	Old water reservoir.	10,000	do	No works required.	Mar. 7, 1894		10,000
41	Spring Gulch.	Calaveras	J. S. White	Calaveras	Old reservoir and dams, Spring Gulch.	645,000	Jan. 31	Works already partly built.	Mar. 13, 1894	27,100	523,900
42	Crane Bros	Yuba	Crane Bros	Yuba	No impounding works required.	1,000	Feb. 5	No works required.	Mar. 7, 1894		1,000
43	Indian Hill [8]	Plumas	Frank Eyraud and Jean Lazzier.	Feather	Dam across natural depression.	118,000	Feb. 6				
44	Badger Hill	do	E. B. Jacks	do	Quincy Mining and Water Company's dam, Spanish Creek.	100,000	Feb. 7				
45	Snow Bros	Eldorado	Snow Bros	American	Timber and brush barrier, Webber Creek.	903,000	Feb. 13	Works already built.	Apr. 3, 1894	11,789	150,000
46	Green Meadow	Calaveras	H. B. Havens	Mokelumne	Brush dams in gulch	93,000	Feb. 15	Mar. 14, 1894	Apr. 17, 1894	27,345	25,000
47	Grub Flat	Plumas	John Tucker, S.C. Brown.	Feather	Brush and log dam in old pit	20,000	do	Apr. 10, 1894	Apr. 14, 1894	1,615	
48	Oriental and Tahoe.	Nevada	James Hackett	Yuba	Brush dam in swale and brush barrier on sloping plain.	58,000	Feb. 16	Apr. 3, 1894	Aug. 6, 1894		13,000
49	Eureka Hydraulic.	Eldorado	Pascoe & Gruben	American	Brush dam, Chile Ravine	24,200	Feb. 19	do	Apr. 10, 1894	3,600	20,600
50	Spanish Hill Hydraulic.	do	Eldorado Water and Deep Gravel Mining Co.	do	2 brush dams, Spanish Ravine	129,000	do	Mar. 28, 1894	do	3,250	11,750
51	Spanish Hill Gravel.	do	Thomas Alderson	do	Brush dam on flat	193,000	do	do	do	1,550	10,450
52	Cleveland	Sierra	Douglas Perkins	North Yuba	Log dam, Rock Creek	125,000	Feb. 24	June 27, 1894			135,000
53	Dutra, Wilder & Co.	Yuba	Lewis Wilder	Yuba	Rock dam across ravine	120,000	Mar. 5	Oct. 23, 1894			4,400
54	Mitchell Hydraulic.	Eldorado	Frank J. Goyan	American	Brush and gravel dam in ravine.	1,161,600	Mar. 7	Oct. 9, 1894	Oct. 23, 1894		5,000
55	Stewart Hydraulic.	do	John Melton	do	Brush dam in ravine	7,250	Apr. 3	Works already built.	May 1, 1894		4,000

[1] Permanently closed Apr. 22, 1894.
[2] Permanently closed May 28, 1894.
[3] Survey required.
[4] Permanently closed Apr. 17, 1894.
[5] Permanently closed June 19, 1894.
[6] Permanently closed Apr. 11, 1894.
[7] Permanently closed Apr. 12, 1894.
[8] Permit refused June 27, 1894.

Synopsis of applications for authority to mine, with action taken thereon—Continued.

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—	Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to Oct. 1, 1894.	Storage capacity yet available partly or wholly completed.
						Cubic yds.	1894.			*Cubic yds.*	*Cubic yds.*
56	Nip and Tuck.	Butte.....	Dickhouse Bros...	Feather	Dam on flat in Robinson Ravine.	12,700	Apr. 19	Sept. 25, 1894	Oct. 2, 1894	.....	5,000
57	Concordia	Plumas	L. V. Tefft	.....do.....	Dams, Cogswell Ravine and Jackson Creek.	1,450,000	May 16	July 3, 1894	.....	.....	.....
58	Northern Placer.	.....do	Northern Placer Mining Co.	.....do.....	Dams, Little Long Valley Creek.	100,000	....do ...	June 27, 1894	Nov. 6, 1894	.....	120,000
59	Schuyler.....	Shasta.....	Thomas White....	Sacramento ...	1 rock and 2 brush dams in Dry Creek.	296,800	June 5	Works already built.	July 23, 1894	.....	.....
60	Hayes & Steelman.	Sierra	Philip Hayes	Feather	Log and brush barriers in excavations.	150,000	June 12	Oct. 23, 1894	.....	.....	150,000
61	Mohawk.....	Plumas	Stephen Soracco..	.....do.....	Log and brush dam in ravine.	16,000	July 17	Aug. 14, 1894	.....	.....	5,000
62	William Tell..	.....do	Frank F. Vanzini.	.....do.....	Log and brush dam, Yankee Ravine.	24,000	....do ...	.....do	.....	.....	.....
63	Garfield Flat .	.....do	Peter Lorenzo	.....do.....	Log and brush dams, Squirrel Creek, common reservoir.	30,000	....do ...	.....do	Nov. 6, 1894	.....	50,000
64	Grizzly Bear..	.....do	Nicola Rossi.....	.....do.....		80,000	....do ...	.....do	.....do	.....	
65	Howard	Shasta.....	James Reagan and J. M. Lowe.	Sacramento ...	2 brush dams in ravine.....	4,500	July 18	Oct. 2, 1894	.....	.....	5,000
66	China Hill....	Amador	Consolidated Amador Volcano Hydraulic Gold Mining and Land Co., of California.	Mokelumne ...	Log and brush dam in South Branch of Sutter Creek.	968,000	July 25	Aug. 14, 1894	Nov. 13, 1894	.....	27,000
67	Elephant	.....do	.....do	.....do.....	Log and rock dam, dry gulch.	330,000	....do ...	.....do	.....	.....	.....
68	Steel & Co....	Yuba	T. H. Steel	Yuba.....	Stone dam on New York Flat.	145,000	....do ...	Works already built.	Sept. 25, 1894	.....	160,000
69	James Watson	Shasta.....	J. C. Voluntine ...	Sacramento ...	Brush dams, Dry Creek and Jackass Gulch.	1,000,000	July 30	Oct. 9, 1894	.....	.....	20,000
70	Volcano Gold Gravel.	Amador	Volcano Gold Gravel Mining Co.	Mokelumne ...	Log and brush dam in Sutter Creek.	32,000	Aug. 16	Sept. 18, 1894	Nov. 13, 1894	.....	100,000
71	Holloway.....	Plumas	J. S. Gould and F. M. Spencer...	Feather	Log and brush dam in canyon.	30,000	Sept. 5	.....	.....	.....	5,000
72	Mugginsville.	Sierra.....	W. A. Morse	North Yuba...	Crib dam in Eureka Creek..	450,000	Sept. 7	Oct. 30, 1894	.....	.....	65,000
73	Waukshaw...	Nevada	John R. Jones.....	South Yuba ...	Rock dam in canyon.....	150,000	Sept. 10	.....	.....	.....	.....
74	U. S. Grant...	.....do	E. P. Hagar and Sam'l Peck.	.....do.....	3 brush dams in dry canyon.	25,000	Oct. 23	.....	.....	.....	.....

75	Richmond Hill	Plumas	Good Hope Mining Co.	Feather	Log crib dam, Onion Valley Creek.	72,600	Oct. 24				
76	Pine Grove	Amador	J. M. Reid and N. E. Beckwith.	Mokelumne	Brush dams, Saw Mill Gulch.	25,000	Nov. 3				
77	Hidden Treasure.	do	do	do	Log and rock dam, Grass Valley Creek.	30,000	do				
78	Martelle	Eldorado	Leonard Dormody.	American	Martelle Creek	30,000	do				
79	Gold Run	Placer	Gold Run Ditch and Mining Co.	do	2 rock dams, North Fork of American River.	11,655,000	do				
80	Spanish John.	Nevada	John Black	Yuba	Log and brush dams in blind ravines.	121,000	Nov. 8				

ANNUAL REPORT OF THE CALIFORNIA DÉBRIS COMMISSION FOR THE FISCAL YEAR ENDING JUNE 30, 1895.

CALIFORNIA DÉBRIS COMMISSION,
San Francisco, Cal., July 1, 1895.

GENERAL: The California Débris Commission has the honor to submit the following, its third annual report:

The Commission was created by act of Congress approved March 1, 1893. Its members are Col. G. H. Mendell, Corps of Engineers, president; Lieut. Col. W. H. H. Benyaurd, Corps of Engineers, and Maj. W. H. Heuer, Corps of Engineers, secretary.

First Lieut. Cassius E. Gillette, Corps of Engineers, has been on duty with the Commission throughout the year as executive and disbursing officer, and in charge of office and records.

The State Débris Commissioner, the Hon. John F. Kidder, has been present at most of the sessions of the Commission, and has accompanied its members in visiting hydraulic mines.

The following civil assistants have been in the employment of the Commission during the time covered by this report (November 15, 1894, to July 1, 1895), inspecting the operations of mines working under permits from the Commission, and looking after illegal mining in the district under the Commission's jurisdiction, viz: Mr. W. B. Storey, jr., from the date of the last annual report to March 11, 1895; Mr. W. W. Waggoner from April 29, 1895, to June 20, 1895; and Mr. Hubert Vischer from March 1, 1895, to the present time.

The jurisdiction of the Commission extends to hydraulic mining in the territory drained by Sacramento and San Joaquin river systems in California.

The duties of the Commission may be briefly stated to be: First, the prevention of such hydraulic mining as may be deemed injurious to the navigable waters within the Commission's jurisdiction, permitting, under proper regulation, such mining in cases where it can be carried on without such injury; second, to mature general plans for the improvement of the rivers whose navigability has been injured by hydraulic mining, and, if practicable, to devise general methods whereby such mining may be carried on without damage to the navigable waters.

The history of hydraulic mining, as affecting the navigable waters above referred to, may be summed up as follows: The rapid washing of the large deposits of auriferous gravel on the western slope of the Sierra Nevada Mountains by the so-called hydraulic process, resulted in the discharging into the canyons of large quantities of gravel, sand, and other detritus, which the floods subsequently carried down, to be at first deposited largely where the streams emerged from the foothills into the level plains of the Sacramento Valley, afterwards to be moved farther down to the navigable streams, and the finer portions even to tide water. The result was that near the foothills the beds of the streams filled up much more rapidly than their banks rose, so that their channels disappeared to a great extent, and at flood time the streams spread over the valley lands, frequently destroying their value by covering the rich alluvium with gravel, sand, etc., often several feet deep. Long and high levees were built by the landowners to prevent as much as possible such damage. The finer particles brought down by the streams were carried into the navigable rivers, filling up the deep pools, and in general changing the character of the bed from a succession of pools and shoals to a continuous shoal. The capacities of the streams to discharge their flood water without overflowing their banks were

reduced. Legal action brought against the mine operators by persons owning damaged lands, and by the United States in the interests of navigation, resulted in injunctions against the principal mines, and ultimately in the practical suppression of hydraulic mining in the region under consideration. Subsequently Congress created the Commission, with the duties as heretofore outlined. For a detailed history of the effects of hydraulic mining, reference is made to House Ex. Doc. No. 98, Forty-seventh Congress, first session; also House Ex. Doc. No. 267, Fifty-first Congress, second session, and to the previous annual reports of the Commission.

PREVENTION OF ILLEGAL MINING.

In accordance with the opinion of the Attorney-General of the United States (Appendix A, Ex. Doc. No. 11, Fifty-third Congress, third session), the Commission has since the date of its last annual report (November 15, 1894) called the attention of the owners and operators of 60 mines which were being worked illegally to the requirements of the law and the duties of the Commission in the matter. So far as known, these mines, with one exception, have been closed, and in 22 cases applications have been subsequently made to the Commission for the permits to mine. These mines are all small. The exception above mentioned is the mine owned and operated by L. V. Tefft, near Cromberg, Plumas County, who persisted in mining by the hydraulic process after having been fully informed of the law and the Commission's duty. Authority has been received from the War Department to bring criminal action against him in the United States courts, in accordance with section 22 of the act of Congress creating the Commission.

In the case of the North Bloomfield Mining Company, which before and since the date of the act of Congress creating the Commission has been operating its mine under a decision of the United States circuit court for this district, the Commission, under date of October 8, 1894, notified the company that if it desired to work its mine thereafter by the hydraulic process it would be necessary to file an application with the Commission. This action was taken in accordance with an opinion of the Attorney-General of the United States, a copy of which is appended and marked A. The company declined to make this application, and resumed operations in its mine. By authority of the Acting Secretary of War, dated November 26, 1894, the facts in the case were on December 4, 1894, furnished the United States district attorney for the northern district of California, with the request that proceedings for an injunction be instituted against the company. The result of such action has not yet been reported to the Commission.

APPLICATIONS AND PERMITS.

The Commission has since it organized received 139 applications to mine, of which number 95 have been given permits. A table showing a synopsis of the applications received and the action taken is appended and marked B.

Four permits have been canceled and 22 permits have been at different times temporarily suspended, generally on account of the neglect of the owners to comply with instructions concerning the impounding works.

In a few cases the dams or other impounding works have been broken or otherwise damaged, but the total amount of material that has escaped has been only a few thousand cubic yards, an insignificant amount.

The total amount of material mined under permits from October 1, 1894, to June 1, 1895, is estimated at 900,000 cubic yards. The available storage provided at present and partially or wholly completed for future operations is estimated at 5,000,000 cubic yards.

The requirements in respect to storage of detritus exacted by the Commission during the past year have not varied from those previously exacted, except that it has been deemed advisable to require even the smallest mines to maintain each enough of a settling pool to restrain the sand carried by the water; the fine mud in such cases, when insignificant in amount, is allowed to escape.

No dam for impounding detritus in the larger streams has as yet been authorized by the Commission.

IMPROVEMENT OF RIVERS.

No data of great importance have been available to the Commission beyond what was on hand at the date of its last annual report, and, therefore, it has been unable to give much further attention to projects on this important subject.

Conditions on the Yuba River, near Marysville, do not appear to have materially changed, but what change has occurred appears to be for the better. The causes for this are doubtless the cessation in the flow of detritus into the river and the improved conditions at the mouth caused by the outlet made by the Government two years ago. No work looking to the retention of detritus by bank protection, alluded to in the last annual report of the Commission, has been done except some preparatory surveying. The exact condition of the river can not well be determined just now, as the water is still at a high stage, but the Commission believes it advisable to postpone action looking to the retention of detritus until further observations determine the result of natural agencies.

A recent survey by the officer in charge of the Feather River shows that exceptionally good water exists for five miles below the mouth of the Bear, indicating that the Feather is at present able to carry off whatever detritus is brought into it by the Bear, and that as far as the improvement of the Feather is concerned no works for the retention of the detritus lying in the Bear need be now considered.

The effect on the general river system of the detritus from the Bear and from the American can not well be determined without more information than is now available. Surveys and examinations will be necessary. Such surveys and examinations will also be necessary before the general problem of the possible permission of hydraulic mining, with general plans of storage, can definitely be determined. Congress, by the act creating the Commission, assigned to it this problem among its other duties, but the funds required to make the necessary surveys have not been provided.

The two most frequently urged plans for the general storage of detritus are storage behind permanent dams in river canyons and storage in the tule lands of the Sacramento Valley. While it is undoubtedly true that a certain amount of permanent storage can be obtained by either plan, it is believed by the Commission that in both cases the cost would be prohibitory. As to the first case, assuming that the cost of the dams should be paid from the profits of the mines concerned, it is to be noted that thus far the owners of no mines or group of mines have asked authority to build permanent dams in the larger canyons, though temporary dams and dams of doubtful permanence have been proposed. While there may be other reasons for this, the strongest

apparent reason is that the owners do not consider that the profits of the mines would justify the expense of constructing the dams. Of the tule lands projects, the one that has been most prominently urged is that of storing in the American Basin, on the east side of the Sacramento River, just north of the American River, and extending up the Sacramento and Feather to the Bear. A project of diverting the Bear and Yuba into this basin was advocated in the last annual report of the commissioner of public works for the State of California. However, no details of the project were given, and only the lump sum of the estimated cost was stated. It is to be noted that projects for such diversion of the Bear and Yuba involve the purchase of from 75,000 to 100,000 acres of land, the building of a levee on at least two sides of the basin (30 miles), the leveeing of the diverted streams on at least one side (20 miles more), the building of costly diverting dams, and the excavation of extensive channels. Adding to these the necessity of crossing several large creeks and a railroad, it will be seen that the project involves items of expense of such magnitude that if the scheme is not impracticable on its face, its feasibility can only be determined after careful estimates, based upon detailed surveys. The facts now known show that the rivers after diversion would have less grade than now, and if they can not transport their load of débris now, it is difficult to see how they could do so after diversion. Additional grade could be obtained by building the diverting dams higher up in the foothills, but the additional expense involved in this would certainly be enormous.

While the Commission does not believe any of these plans to be economically practicable, it is unable, from lack of data, to state even approximately the cost involved.

Money statement.

Balance available from last appropriation	$4,348.00
Estimated necessary for expenses of Commission and surveys	20,000.00

Respectfully submitted.

G. H. MENDELL,
Colonel, Corps of Engineers.
W. H. H. BENYAURD,
Lieut. Col., Corps of Engineers.
W. H. HEUER,
Major, Corps of Engineers.

Brig. Gen. WM. P. CRAIGHILL,
Corps of Engineers, U. S. A.

APPENDIX A.

LETTER OF THE ATTORNEY-GENERAL OF THE UNITED STATES.

DEPARTMENT OF JUSTICE,
Washington, D. C., September 24, 1894.

SIR: I have the honor to acknowledge the receipt of the letter of the Acting Secretary of War inquiring whether or not the North Bloomfield Gravel Mining Company, of California, falls within the jurisdiction of the California Débris Commission, under the act of Congress approved March 1, 1893, and entitled "An act to create the California Débris Commission and regulate hydraulic mining in the State of California," and inquiring also whether, in view of the fact that the said mining company has never made application to the said Commission for license to operate, as required by the terms of said act, the Commission has "authority to enter upon the premises for the purpose of inspecting or supervising the operation of the mine,

or performing any of the duties devolved by the said act upon the Commission in respect thereto, and, if it has that authority, and is forbidden by said company to enter upon its premises for that purpose, by what means can the Commission enforce its said authority."

In reply I beg to state that in my opinion there is no reason whatever why the company mentioned should not come, equally with any other company or individual engaged in hydraulic mining, within the jurisdiction and under the authority of the Commission. The claim of the company that under the decision of the circuit court of the United States for the northern district of California, in the case of the United States *v.* the same company (53 Fed. Rep., 625, dated October 5, 1892), the defendant was removed beyond the provision and operation of the law creating the Commission, I deem utterly untenable. At the time of the trial and decision of the case mentioned that law was not in existence; consequently, it could not have been construed or the extent of its operations defined by the court. Moreover, the decision referred to was only to the effect that an injunction to restrain hydraulic mining by the defendant should be denied for the reason that there was not sufficient showing of damage to the navigability of public waters. But whatever might have been the status of the company prior to the enactment of the débris law, that law has become operative upon it as well as upon all others conducting the business of hydraulic mining; and this company, if engaged in such mining and without license, is doing so in violation of law, for it is provided by section 9 of said act (27 Stat., p. 508), "that the individual proprietor or proprietors, or in the case of a corporation, its manager or agent appointed for that purpose, owning mining ground in the territory in the State of California mentioned in section 3 hereof, which it is desired to work by the hydraulic process, must file with said Commission a verified petition setting forth such facts as will comply with law and the rules prescribed by the Commission."

The right of the Commission to enter upon the lands of the company where such mining is being or is supposed to be unlawfully conducted seems entirely clear under the provisions of section 5 of said act. This section, after directing that the Commission shall make examinations and surveys to determine the practicability, utility, etc., of storage sites for débris, reservoirs, etc., to aid in the improvement and protection of the rivers within its jurisdiction, and to that end preventing, among other matters, the deposit of débris resulting from mining operations, declares that the Commission shall "* * * investigate such hydraulic and other mines as now are or may have been worked by methods intended to restrain the débris and material moved in operating such mines, by impounding dams, settling reservoirs, or otherwise, and in general to make such study of and researches in the hydraulic mining industry as sound experience and engineering skill may suggest as practicable and useful in devising a method or methods whereby such mining may be carried on as aforesaid."

By section 20 of said act it is provided "that said Commission or a committee therefrom, or officer of said corps assigned to duty under its orders, shall, whenever deemed necessary, visit said territory and all mines operating under the provisions of this act * * *." By section 22 of this act hydraulic mining contrary to the provisions of the act, to the injury, direct or indirect, of navigable waters, is made a misdemeanor punishable by fine and imprisonment; while by section 5 the power to investigate mines is given in relation to those that "*are now* or may have been" worked. I think that the law intended thus to give to the Commission ample means for ascertaining the method of conduct of the mining industry with a view to the protection of the navigable waters concerned and the punishment of the violators of the law, and that such means necessarily include the right to enter upon and inspect premises even at the present time.

I am unable to find in the act in question any provision for the enforcement of the right of the Commission to enter upon lands for the examination of mines; and, in the absence of such express provision, am of the opinion that the preferable course would be the filing of a bill in equity, alleging (among other and unusual matters) that the company is conducting hydraulic mining without a license and without application for license, and, as believed, to the injury of navigation of the streams; that the Commission desire to investigate concerning the method of mining, construction of reservoirs, etc., and to that end have attempted to enter upon the land, but have been denied admittance; the prayer of the bill to be for an injunction to prevent the defendants from preventing the entry of the Commission and for injunction restraining the defendants from mining during the time the Commission is excluded by it and pending the investigation.

Respectfully,

RICHARD OLNEY,
Attorney-General.

The SECRETARY OF WAR.

APPENDIX B.—*Synopsis of applications for*

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—
1	Kelly Hill*	Butte	R. M. Mooer	Sacramento
2	Farrel	Nevada	Eureka Lake and Yuba Canal Co.	Middle Yuba
3	Omega	do	N. C. Tully	South Yuba
4	Brandy City	Sierra	A. Steinberger	Mid le Yuba
5	Blue Nose	Plumas	B. Below	Middle Feather
6	Blue Gravel	Yuba	Excelsior Water and Mining Co.	Yuba
7	Illinois Gold Gravel	Plumas	H. Buckley and Louis L. Hillman.	do
8	New York Gold Gravel	Sierra	Westall & Hughes	South Yuba
9	Corbiere & Bean	Butte	Corbiere & Bean	North Yuba
10	Phœnix Gold Gravel	Sierra	W. A. & M. E. Schofield	do
11	Eureka Mining Co	do	Eureka Mining Co	do
12	Craycroft Mining Co	do	Craycroft Mining Co	do
13	Excelsior Hydraulic	do	Excelsior Mining Co	do
14	Spanish Ranch	Plumas	Quincy Mining and Water Co.	North Feather
15	Gopher Hill	do	do	do
16	Polar Star†	Placer	John Spaulding	Bear
17	A. Denmire	Sierra	A. Denmire	North Yuba
18	Nevada	do	George W. Cox	Yuba
19	Fifty Four Flat†	Amador	Fifty Four Flat Mining Co.	Mokelumne
20	Red Hill‡	Shasta	Nathan Gardiner	Sacramento
21	Badger	do	W. R. Stewart	Cottonwood
22	First Chance	Sierra	Frank E. Barbero	North Yuba
23	Tannery Ravine	Yuba	W. R. Reed	Yuba
24	Mateos	Sierra	Manuel Mateos	North Yuba
25	Davis	do	Joseph Davis	do
26	Christmas Hill	Placer	Hannah McKinstry, E. E. McKinstry, and E. B. Gilbert.	American
27	Walker†	Shasta	Olonzo Engle and Frank Walker.	Cottonwood
28	North Star†	Calaveras	Philip McGuire, Philip McGuire, jr., and B. McGuire.	Mokelumne
29	Hustler§	Nevada	Joseph Hustler	South Yuba
30	Green Mountain†	Calaveras	J. W. Smith	Calaveras
31	Noonday	Sierra	John Egbert	North Yuba
32	Pomroy†	Shasta	John McGrew and Olonzo Engle.	Cottonwood
33	Union	Plumas	David W. Albert	Yuba
34	Welch Placer	Sacramento	Columbia Gold Mining Co.	Cosumnes
35	French Corral	Nevada	Kate Hayes Mining Co	South Yuba
36	Manzanita	do	do	Main Yuba
37	Campo†	Yuba	Fausteno Campo	Yuba
38	Herring Ravine	Yuba	J. M. Wetmore	do

* Mine closed; permit canceled.
† Mine closed.
‡ Lower dam broke Oct. 23, 1894.
§ Dam broke Nov. 25, 1894.

authority to mine, with action taken thereon.

Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1895.	Storage capacity yet available, partly or wholly completed.
	Cu. yds.	1893.				
Rock dam 30 feet high in dry ravine, side spillway cut in rock.	1,000,000	Aug. 2	Sept. 9, 1893	Mar. 27, 1894	9,000	.....
Dam 12 feet high of earth and logs, across mouth of old hydraulic pit.	212,000	Aug. 11	Works already built.	Sept. 8, 1893	96,000	120,000
Dam 80 feet high in Scotchman Creek, of brush and gravel, side spillway cut in rock.	2,160,000	Aug. 16	Sept. 9, 1893	.....	.....	1,000,000
Brush and earth dam across mouth of old hydraulic pit.	1,520,000	Sept. 19	Oct. 25, 1893	Oct. 9, 1894	37,000	903,000
Stone dam in Hopkins Creek..	50,000	....do ...	.....	.....	.....	.....
Old hydraulic pit, with tunnel stopped with rock.	604,000	Sept. 27	Works already built.	Oct. 17, 1893	529,614	1,340,000
.....do.....	35,000	Sept. 29	Jan. 4, 1894	Jan. 31, 1894	7,351	100,000
Brush, log, and earth dam, Howard Creek, spillway in rock.	484,000	Oct. 12	Nov. 21,1893	Dec. 5, 1893	20,600	60,000
Rock dam 10 feet high in Hampshire Creek.	12,000	Oct. 9	Works already built.	Nov. 21, 1893	5,000	5,000
Dams, Whisky Creek and North Fork of Slate Creek.	1,660,000	Oct. 14	June 27, 1894	.....	.....	.....
Timber dams in Sam Mill Ravine.	553,000	Oct. 16	Nov. 21, 1893	May 29, 1894	24,000	5,000
Timber dams, Hughes and Davidson ravines.	140,000	....do ...	.....do	.....do	15,500	3,000
Timber dams, Eagle Gulch and Smiths Flat.	277,000	....do ...	.....do	.....do	16,000	4,000
Timber dams, Spanish Creek and old hydraulic pit.	3,000,000	Oct. 18	.....	.....	.....	.....
.....do.....	2,000,000	....do ...	Dec. 6, 1893	Apr. 14, 1894	309,000	109,000
Stone and gravel dam in Little Bear River with spillway.	605,000	Nov. 3	Works already built.	Dec. 13, 1893	12,800	.....
Dams in dry ravine	17,000	Nov. 6	Dec. 13, 1893	Nov. 20, 1894	1,000	19,000
Dams, North Branch Slate Creek.	10,000	Nov. 14	June 27, 1894	.....	.....	.....
Brush dam in ravine.....	15,000,000	....do ...	Jan. 11, 1894	Feb. 6, 1894	34,446	.....
5 dams in gulch	750,000	Nov. 16	Jan. 4, 1894	.....do	4,500	1,000
Flat ground	2,500	Nov. 29	No works required.	Jan. 2, 1894	35	3,000
Bowlder, log, and brush dam, Howards Creek.	200,000	Dec. 4	Works already built.	...do	800	3,000
Log and brush dam in ravine .	9,000	....do ...	Jan. 4, 1894	Jan. 10, 1894	70	2,000
Westall & Hughes, dam, Howards Creek.	.....	....do ...	Works already built.	Jan. 2, 1894	.....	....
Westall & Hughes dam, Howards Creek.	.....	....do ...	.....do	...do	4,040	.....
....	200,000	Dec. 5	.....	.....	.....	.....
1 rock and 4 brush dams, Pomroy Gulch	675,000	Dec. 8	Jan. 4, 1894	Jan. 31, 1894	1,076	.....
Dams, Buckeye Gulch.....	500,000	Dec. 13	...do	Jan. 10, 1894	31,618	.....
Gravel Dam, Gilroy Cut	90,000	Dec. 17	Jan. 31, 1894	Aug. 13, 1894	4,280	5,000
Old hydraulic pit, with brush dam.	250,000	....do ...	Jan. 4, 1894	Jan. 8, 1894	3,534	.....
Flat, near mine.....	40,000	Dec. 26	No works required.	Oct. 23, 1894	1,800	45,000
Rock dam, Pomroy Gulch.....	1,400,000	....do ...	Works already built.	Jan. 31, 1894	3,737	.....
Rock and brush dam in French Gulch.	3,200	....do ...	Mar. 7, 1894	Mar. 27, 1894	460	3,000
Stone dam.....	161,000	Dec. 27	Jan. 31, 1894	Feb. 10, 1894	89,368	40,000
Old hydraulic pit.....	450,000	....do ...	.....do	Mar. 13, 1894	.....	.....
.....do.....	1,169,500	....do ...	Apr. 10, 1894	May 1, 1894	660,000	.....
Rock dam in gulch.....	1,000	Dec. 29	Works already built.	Mar. 7, 1894	.....	.....
		1894				
Rock and brush dam 1 mile below mine.	660	Jan. 10	.....do	.....do	390	.....

APPENDIX B.—*Synopsis of applications for authority*

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—
39	Conduit Ravine	Yuba	W. W. & W. A. Lemon	Yuba
40	Motor *	do	Jas. Gordon	do
41	Spring Gulch †	Calaveras	J. S. White	Calaveras
42	Crane Bros ‡	Yuba	Crane Bros	Yuba
43	Indian Hill §	Plumas	Frank Eyraud and Jean Lazzier.	Feather
44	Badger	do	E. B. Jacks	do
45	Snow Bros	Eldorado	Snow Bros	American
46	Green Meadow	Calaveras	H. B. Havens	Mokelumne
47	Grub Flat	Plumas	John Tucker and S. C. Brown	Feather
48	Oriental and Tahoe	Nevada	James Hackett	Yuba
49	Eureka Hydraulic ‖	Eldorado	Pascoe & Gruben	American
50	Spanish Hill Hydralic	do	Eldorado Water and Deep Gravel Mining Co.	do
51	Spanish Hill Gravel †	do	Thos. Alderson	do
52	Cleveland	Sierra	Douglas Perkins	North Yuba
53	Dutra, Wilder & Co	Yuba	Lewis Wilder	Yuba
54	Mitchell Hydraulic	Eldorado	Frank J. Goyan	American
55	Stewart Hydraulic	do	John Melton	do
56	Nip and Tuck	Butte	Dickhouse Bros	Feather
57	Concordia	Plumas	L. V. Tefft	do
58	Northern Placer	do	Northern Placer Mining Co	do
59	Schuyler	Shasta	Thomas White	Sacramento
60	Hayes & Steelman	Sierra	Philip Hayes	Feather
61	Mohawk	Plumas	Stephen Soracco	do
62	William Tell	do	Frank F. Vanzini	do
63	Garfield Flat	Plumas	Peter Lorenzo	Feather
64	Grizzly Bear	do	Nicola Rossi	do
65	Howard	Shasta	James Reagan and J. M. Lowe	Sacramento
66	China Hill	Amador	Con. Amador Volcano Hydraulic Gold Mining and Land Land Co. of California.	Mokelumne
67	Elephant	do	do	do
68	Steel & Co	Yuba	T. H. Steel	Yuba
69	James Watson	Shasta	J. C. Voluntine	Sacramento
70	Volcano Gold Gravel	Amador	Volcano Gold Gravel Mining Co.	Mokelumne
71	Holloway	Plumas	J. S. Gould and F. M. Spencer	Feather
72	Mugginsville	Sierra	W. A. Morse	North Yuba
73	Waukshaw	Nevada	John R. Jones	South Yuba
74	U. S. Grant ¶	Nevada	E. P. Hagar and Samuel Peck	South Yuba
75	Richmond Hill	Plumas	Good Hope Mining Co	Feather
76	Pine Grove	Amador	J. M. Reid and N. E. Beckwith	Mokelumne
77	Hidden Treasure	do	do	do
78	Martelle	Eldorado	Leonard Dormody	American
79	Gold Run	Placer	Gold Run Ditch and Mining Co,	do
80	Spanish John	Nevada	John Black	Yuba
81	North Rim	Placer	G. H. Pease and J. B. Colwell	American
82	Crown Point	Plumas	Crown Point Mining Co	Feather
83	Spring Valley	Butte	Mariano C. Mello and John Costa.	do

* Permit canceled.
† Mine closed.
‡ Mine worked out.
§ Permit refused June 27, 1894.
‖ Dam broke Jan. 4, 1895; mine closed.
¶ Mine closed; permit canceled.

to mine, with action taken thereon—Continued.

Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1895.	Storage capacity yet available, partly or wholly completed.
	Cu. yds.	1894.				
Rock and brush dam	10,000	Jan. 21	Mar. 7, 1894	Mar. 27, 1894	.....	.....
Old water reservoir	10,000	....do ...	No works required.	Mar. 7, 1894	200	1,000
Old reservoir and dams, Spring Gulch.	645,000	Jan. 31	Works already partly built.	Mar. 13, 1894	27,100	.....
No impounding works required.	1,000	Feb. 5	No works required.	Mar. 7, 1894	.....	.....
Dam across natural depression.	118,000	Feb. 6	.....	.....	.....	.....
Quincy Mining and Water Co.'s dam, Spanish Creek.	100,000	Feb. 7	.....	.....	.....	.....
Timber and brush barrier, Webber Creek.	903,000	Feb. 13	Works already built.	Apr. 3, 1894	35,000	100,000
Brush dams in gulch	93,000	Feb. 15	Mar. 14, 1894	Apr. 17, 1894	27,345	5,000
Brush and log dam in old pit	20,000	....do ...	Apr. 10, 1894	Apr. 14, 1894	2,615	2,000
Brush dam in swale and brush barrier on sloping plain.	58,000	Feb. 16	Apr. 3, 1894	Aug. 6, 1894	1,000	12,000
Brush dam, Chili Ravine	24,200	Feb. 19	.....do	Apr. 10, 1894	7,600	.....
2 brush dams in Spanish Ravine	129,000	....do ...	Mar. 28, 1894	.....do	5,250	8,000
Brush dam on flat	193,000	....do ...	.....do	.....do	.....	.....
Log dam, Rock Creek	125,000	Feb. 24	June 27, 1894	Nov. 27, 1894	10,000	35,000
Rock dam across ravine	120,000	Mar. 5	Oct. 23, 1894	Feb. 5, 1895	1,000	3,400
Brush and gravel dam in ravine	1,161,600	Mar. 7	Oct. 9, 1894	Oct. 23, 1894	3,000	15,000
Brush dam in ravine	7,250	Apr. 3	Works already built.	May 1, 1894	.....	.....
Dam on flat in Robinson Ravine	12,700	Apr. 19	Sept. 25, 1894	Oct. 2, 1894	1,000	2,000
Dams, Cogswell Ravine and Jackson Creek.	1,450,000	May 16	July 3, 1894	.....	.....	.....
Dams, Little Long Valley Creek.	100,000	....do ...	June 27, 1894	Nov. 6, 1894	20,000	.....
1 rock and 2 brush dams in Dry Creek.	296,800	June 5	Works already built.	July 23, 1894	11,000	20,000
Log and brush barriers in excavations.	150,000	June 12	Oct. 23, 1894	.....	.....	150,000
Log and brush dam in ravine	16,000	July 17	Aug. 14, 1894	.....	.....	5,000
Log and brush dam, Yankee Ravine.	24,000	....do ...	.....do	.....	.....	.....
Log and brush dams, Squirrel Creek.	30,000	....do ...	.....do	Nov. 6, 1894	1,500	*45,000
Common reservoir	80,000	....do ...	.....do	.....do	3,500	
Two brush dams in ravine	4,500	July 18	Oct. 2, 1894	.....	.....	.....
Log and brush dam in South Branch of Sutter Creek.	968,000	July 25	Aug. 14, 1894	Nov. 13, 1894	2,000	20,000
Log and rock dam in Dry Gulch	330,000	....do ...	.....do	.....	.....	.....
Stone dam on New York Flat	145,000	....do ...	Works already built.	Sept. 25, 1894	10,000	105,000
Brush dam, Dry Creek and Jackass Gulch.	1,000,000	July 30	Oct. 9, 1894	Mar. 12, 1895	25,000	50,000
Log and brush dam, Sutter Creek.	32,000	Aug. 16	Sept. 18, 1894	Nov. 13, 1894	15,000	15,000
Log and brush dam in canyon.	30,000	Sept. 5	Works already built.	Nov. 20, 1894	2,500	5,000
Crib dam in Eureka Creek	450,000	Sept. 7	Oct. 30, 1894	.....	.....	.....
Bock dam in canyon	150,000	Sept. 10	.....	.....	.....	.....
3 brush dams in Dry Cañyon	25,000	Oct. 23	Nov. 27, 1894	Dec. 17, 1894.	3,300	.....
Log crib dam in Onion Valley Creek.	72,000	Oct. 24	.....do	.....	.....	.....
Brush dams, Saw Mill Gulch	25,000	Nov. 3	.....do	Jan. 8, 1895	4,000	2,000
Log and rock dam in Grass Valley Creek.	30,000	....do ...	.....do	.....	.....	.....
Martelle Creek	30,000	....do ...	Jan. 22, 1895	Feb. 18, 1895	200	100
2 rock dams, North Fork American River.	11,655,000	....do ...	.....	.....	.....	.....
Log and brush dams in blind ravines.	121,000	Nov. 8	Nov. 27, 1894	Dec. 17, 1894	5,000	10,000
Dam, Mexican Gulch	10,000	Nov. 20	Feb. 12, 1895	Feb. 26, 1895	4,000	6,000
Log and brush dam, Porter Ravine.	45,000	Nov. 26	.....	Apr. 15, 1895	1,500	10,000
Rock dam, Saw Mill Gulch	484,000	Dec. 3	Feb. 26, 1894	.....	.....	.....

* Joint reservoir.

APPENDIX B.—*Synopsis of applications for authority*

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—
84	Kentucky Flat	Eldorado	H. E. Picket	American
85	Johnson	Amador	William Johnson	Sacramento
86	Henrietta *	Eldorado	Eldorado Water and Deep Gravel Mining Co.	American
87	Leroy Hedge	Yuba	Leroy Hedge	Yuba
88	Epley	Eldorado	Louis Rolland and Alonzo Vanderberg.	American
89	York Mining Co	Yuba	York Mining Co	Yuba
90	Last Chance	Eldorado	Edward Hancock and W. H. Daly.	American
91	Goodman & Bund	Amador	Goodman & Bund	Mokelumne
92	Goodman Bros	do	F. A. Goodman and W. H. Goodman.	do
93	'49 Flat	do	Geo. W. Hadley and —— Bolles.	do
94	Fine Gold	Calaveras	G. A. Meinecke, Chas. Sanguinette, and J. S. Shepherd.	Stanislaus
95	American House	Plumas	A. Blair	Feather
96	Central Hill Placer	Calaveras	Wm. Thomas, sr., M. McCormick, W. A. Bisbee, W. Thomas, jr.	Stanislaus
97	Kate Gray	Amador	Giovanni Rossi	Mokelumne
98	Spring Tunnel and Spring Canyon.	Eldorado	Jay E. Russell	American
99	Shealor	Amador	J. E. Newsom	Mokelumne
100	Railroad Hill Gravel	Calaveras	Giani, R. T. Luigi, and Luigi Demartini.	Calaveras
101	James Slater	Yuba	James Slater	Yuba
102	Grizzly Hill	Amador	Moy Jin Mun	Mokelumne
103	Deer Valley	Eldorado	Wullf Bros	American
104	Strawberry Placer	Calaveras	John Enos	Stanislaus
105	Mount Gregory Gold	Eldorado	Porter Phillips	American
106	Red Hill and Telegraph Hill.	Amador	Geo. R. Evans, John Erickson, and M. Fitzgerald.	Mokelumne
107	Blacklock	Eldorado	Geo. W. Edwards	American
108	Kelly & Matherly †	Placer	M. A. Kelly and W. H. Matherly.	Sacramento
109	Dry Gulch	Amador	O. M. Henry	
110	Saw Mill Flat	Shasta	J. K. Williams	Sacramento
111	Mooney Placer	Eldorado	Thomas Ewing	American
112	Grizzly Flat	do	Geo. Wheeler and Moses C. Wheeler.	Cosumnes
113	Gold Deposit	do	David Croft	American
114	Railroad Placer	do	Wm. Franklin Coe	do
115	Independence	Yuba	John A. Broyles	Yuba
116	J. C. Day	Eldorado	J. C. Day	American
117	Iowa	Placer	Wm. H'y and John Henning	do
118	Tiger	do	Jas. Ward and Wm. McDonald.	do
119	Hard Times	do	Jos. J. and A. A. Hoffman and H. McDonald.	do
120	Eldorado Placer	Eldorado	Wm. and W. J. S. Bacchi	do
121	Zantgraf & Closs	do	J. Zantgraf and J. J. Closs	
122	St. Lawrence	Nevada	Ah Wing	Yuba
123	Polar Star ‡	Placer	John Spaulding	Bear
124	Liberty Hill ‡	Nevada	T. G. Phelps	do
125	Lost Camp	Placer	J. B. Rathburn et al	American
126	McFadden	Calaveras	A. J. Mason	Mokelumne
127	Joubert	Yuba	Fredk. Joubert	Yuba

* Mine worked out.

† Permit refused Apr. 8, 1895.

‡ Permit refused May 20, 1895.

to mine, with action taken thereon—Continued.

Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1895.	Storage capacity yet available, partly or wholly completed.
	Cu. yds.	1894.				
Log and brush dam, North Otter Creek.	100,000	Dec. 5	Works already built	Feb. 5, 1895	3,000	94,000
Brush dam in ravine	100,000	Dec. 10	Jan. 15, 1895			
do	7,000	Dec. 11	Works already built.	Jan. 22, 1895	750	
Brush, log, and rock dam below mine.	2,500	Dec. 14	do	Feb. 5, 1895	308	2,000
Brush, gravel, and rock dam in ravine.	3,500	Dec. 18	do	Jan. 22, 1895	200	
Brush and log dam, below mine.	4,000	Dec. 20	do	Feb. 5, 1895	2,500	1,500
Brush and gravel dams, Hancock Ravine.	50,000	Dec. 21	do	Jan. 22, 1895	8,000	
Timber and brush dam, Ashland Branch, Sutter Creek.	100,000	Dec. 24	do	Jan. 14, 1895	5,000	* 20,000
do	50,000	do	do	do	1,000	
Log and brush dam, '49 Gulch.	250,000	Dec. 26	do	do	24,000	20,000
Rock and brush dam, Skunk Ravine.	4,000	Dec. 27	Feb. 26, 1895	Mar. 5, 1895	2,000	4,000
		1895				
Dams, American House Ravine	2,500	Jan. 7		May 13, 1895	200	
Rock and stone dam	1,000,000	do		Mar. 25, 1895	4,200	200,000
Brush dam	10,000	do	Feb. 26, 1895	Mar. 5, 1895	550	13,000
Brush dams, Spring Canyon	56,000	Jan. 17	Apr. 23, 1895			
Log, rock, and brush dam, Sutter Creek.	1,500	Jan. 29	Works already built.	Mar. 5, 1895	250	1,250
Brush dam in dry gulch	48,000	Feb. 1	do	Feb. 26, 1895	4,200	20,000
York Mining Co.'s dam	30,000	Feb. 4	do	do		
Brush dam in ravine	300,000	Feb. 12	Mar. 19, 1895	Apr. 8, 1895	100	5,000
Log and brush dams and old pit.	5,000	Feb. 13	Works already built.	Mar. 18, 1895		5,000
2 rock dams in dry gulch	3,000	do	do	do	700	2,300
Brush and log dam in dry ravine.	200,000	Feb. 20	do	Apr. 22, 1895		
Log crib dam, Chili Gulch	15,000	Feb. 23	do	Mar. 18, 1895	4,200	5,000
Brush and gravel dam, Spanish Ravine.	403,000	Mar. 1	do	Apr. 1, 1895	1,000	
Worked-out pit, Rattlesnake Bar.	20,000	Mar. 5				
Brush dam below mine	10,000	Mar. 7	Works already built.	Apr. 8, 1895	500	1,000
Worked-out pits	30,000	Mar. 8	May 13, 1895			
Log and brush dam, worked-out pit.	968,000	Mar. 13	Works already built.	Apr. 1, 1895	3,000	5,000
Log and brush dam, Grizzly Flat.	10,000	Mar. 16	Apr. 1, 1895	do		5,000
Retaining wall, old hydraulic pit.	18,000	Mar. 22	Works already built.	Apr. 22, 1895	100	18,000
Brush dam on mine property	3,000	Mar. 23	Apr. 23, 1895			
Letson Ravine	1,800	Mar. 27				
Brush dam in ravine	1,000	do	Apr. 23, 1895			
do	1,150	Mar. 29	do	May 13, 1895	200	1,000
do	7,000	Apr. 1	do	do		2,000
Brush barriers and old hydraulic pit.	30,000	do	Works already built.	Apr. 22, 1895	1,650	7,000
Brush dam in small stream	4,000	Apr. 3	do	do		4,000
Worked-out pit	4,200	Apr. 9	do	Apr. 29, 1895		4,200
Brush Dam in Illinois Canyon.	150,000	Apr. 15				
Liberty Hill Dam, Bear River	2,000,000	Apr. 17				
do	144,000	Apr. 25				
Log and brush dam, Woods Ravine.	180,000	Apr. 29				
Rock and brush dam, Buckeye Gulch.	240,000	May 27	June 17, 1895			
Old pits and dams, Willow Creek.	420,000	June 3				

* Joint reservoirs.

APPENDIX B.—*Synopsis of applications for authority*

No.	Name of mine.	County.	Name of applicant.	Mine drains into tributary of—
128	Sailor boy	Sierra	Michael Cortez	Yuba
129	Plumas Imperial	Plumas	Plumas Imperial Gold Mining Co.	Feather
130	Horse Valley	Yuba	M. V. Turner, Mrs. E. M. Brown, and Wm. Wellman.	Yuba
131	Youngs Hill	do	Wm. Wellman	do
132	Atom	do	E. C. Cochran and Charles Turner.	do
133	Galena Hill	do	W. R. and M. J. Williams	do
134	Tippecanoe	do	George Parent	do
135	O'Keeffe	Sierra	D. O. O'Keeffe	do
136	Charcoal Ranch	do	L. F. Fourier and John Barrere	do
137	Sharp	do	E. C. Kendall, J. C. Peterson, and H. Kimball.	do
138	Homestake	do	C. Wichman, W. Elkins, W. R. and B. F. Atkinson.	Feather
139	Corkscrew	do	S. F. Toland and G. W. Langdon.	do

to mine, with action taken thereon—Continued.

Nature of tailings reservoir proposed for present use.	Approximate amount of gravel proposed to mine.	Application received.	Order issued to build impounding works.	License granted.	Mined and stored previous to June 1, 1895.	Storage capacity yet available, partly or wholly completed.
	Cu. yds	1895.				
Brandy City Mine's dam	20,000	June 3				
Rock dam in Rock Creek	120,000	June 11				
Brush dam in Horse Valley Creek.	12,000	....do				
Brush dams in a dry gulch	5,000	....do				
Brush dams in Williamson Creek.	70,000	....do				
Old hydrualic pit, Galena Hill.	84,000	....do				
Brush dam in Spanish Ravine.	32,000	....do				
Closing waste cuts, hydraulic pit.	6,000	June 15				
Flat adjacent to mine	150,000	....do				
Brush dam Sharp ravine, old pit and reservoir.	200,000	June 24				
Dam, blind ravine	15,000	June 25				
Brush dam, bank of Spanish Ravine.	25,000	June 28				

APPENDIX Z Z.

OCCUPANCY OF AND INJURY TO PUBLIC WORKS BY CORPORATIONS AND INDIVIDUALS.

[Reported under section 2, river and harbor act of 1884, and section 4, river and harbor act of 1886.]

1. Report of Lieut. Col. Peter C. Hains, Corps of Engineers.
2. Report of Capt. O. M. Carter, Corps of Engineers.
3. Report of Lieut. Wm. L. Sibert, Corps of Engineers.
4. Report of Maj. D.W. Lockwood, Corps of Engineers.
5. Report of Maj. Clinton B. Sears, Corps of Engineers.
6. Report of Maj. W. L. Marshall, Corps of Engineers.
7. Report of Col. O. M. Poe, Corps of Engineers.
8. Report of Lieut. Col. Jared A. Smith, Corps of Engineers.
9. Report of Capt. Dan C. Kingman, Corps of Engineers.

(1) REPORT OF LIEUT. COL. PETER C. HAINS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Baltimore, Md., July 8, 1895.

GENERAL: In compliance with the requirements of General Orders Nos. 6 and 7, series of 1887, and 9 of 1888, from Headquarters Corps of Engineers, I have the honor to report, concerning the rivers and harbors in my charge, that no additional information on the subject of those orders has been received by me since the last annual report, except as shown by the following statements:

In regard to putting refuse in the streams: On the Great Kanawha River, West Virginia, there has been no material trouble at the movable dams from this source. The sawmills, with one exception, so far as this office is advised, have either been burning their slabs, sawdust, etc., or putting it where it is not liable to be washed into the streams. The exception referred to is that of the Marmet-Smith Coal and Mining Company at Raymond City in the No. 8 pool. This company has been operating a small mill at their works and throwing part of the refuse on the bank where it would be carried into the river by high water. They continued to do this at times after having their attention called to the matter and being furnished with a copy of the extract from the river and harbor act of September 19, 1890, concerning such acts. United States district attorney, Gen. C. C. Watts, was notified of this violation of the law by letter dated April 18, 1895. General Watts states that it is the purpose to bring the matter to the attention of the next grand jury.

The Charleston, Clendennin and Sutton Railroad Company is now building their road along the banks of Elk River, West Virginia. There has been some complaint by Elk lumber and boat men about this company, or its contractors, cutting and felling timber into the river or on the banks. The attention of the officers of the company has been called to the matter, and they have had a considerable part of the fallen timber cut up and removed. They are still working at it and will, it is thought, get it all out of the way within reasonable time. The officers of the company appear anxious to conform to the requirements of the law in the matter.

There has been no change in the status of the old milldams on Elk River, West Virginia, during the year. The Secretary of War has requested the Attorney-General to have proceedings instituted for the removal of the Frametown and Ashley dams.

The Elk Island Boom at Sutton and the temporary dam built by the boom company just below their boom remain in practically the same condition as when reported on last year, and described in Colonel Craighill's report of July 3, 1894 (Report of Chief of Engineers for 1894, p. 3190). In the first trial under the indictment of the company by the grand jury of Braxton County, on account of this temporary dam, the jury failed to agree. So far as this office is informed a second trial has not yet been had.

Very respectfully, your obedient servant,

PETER C. HAINS,
Lieut. Col., Corps of Engineers.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

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(2) REPORT OF CAPT. O. M. CARTER, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Savannah, Ga., June 30, 1895.

GENERAL: I have the honor to report that "no structures or works built or made by the United States in aid of commerce or navigation" within the district under my charge "have been used, occupied, or injured by a corporation or individual" during the year, with the following exceptions:

1. On September 4, 1894, the steamship *Chatham* of the Merchants and Miners' Transportation Company, of Baltimore, Md., ran into and damaged the Barnwell Island training wall, Savannah Harbor, to the extent of $1,753.17.

2. On October 1, 1894, the steamship *Chattahoochee* of the Ocean steamship Company, of Savannah, Ga., ran into and damaged the same wall to the extent of $2,243.38.

Those cases have been brought repeatedly to the attention of the United States attorney for the southern district of Georgia, as required by law, but so far as known no steps have been taken by him looking to the collection of the amount of damages as provided by law.

3. On December 3, 1894, the British steamship *Guildhall* ran into and damaged spur No. 8, Jones Island, Savannah Harbor, Georgia, to the extent of $370. The vessel escaped to sea before it could be libeled and has not been in port since.

4. On December 26, 1894, the Spanish steamship *Conde Wifredo* ran into and damaged the Barnwell Island training wall. The sum of $500

was deposited to the credit of the appropriation for improving harbor at Savannah, Ga. The damage has been repaired.

5. Some minor injuries of pile training walls have been caused by unknown parties and small quantities of stone have been removed from dams in the vicinity of Big Gap, Savannah Harbor, Georgia.

Respectfully submitted.

O. M. CARTER,
Capt., Corps of Engineers.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

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(3) REPORT OF LIEUT. WM. L. SIBERT, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Little Rock, Ark., June 30, 1895.

GENERAL: I have the honor to report that "no structures or works built or made by the United States in aid of commerce or navigation" within the district under my charge "have been used, occupied, or injured by a corporation or individual" during the year, with the following exception:

The Pine Bluff Water, Gas and Electric Light Company used Dike No. 2, Pine Bluff and Rob Roy Reach, Arkansas River, at Pine Bluff, Ark., as an intake pier for the suction pipe of their waterworks.

A license, revocable at will, by the Secretary of War, issued September 10, 1894, grants the use of this dike for the purpose above stated.

I have the honor to be, very respectfully, your obedient servant,

WM. L. SIBERT,
First Lieut., Corps of Engineers.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

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(4) REPORT OF MAJ. D. W. LOCKWOOD, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Cincinnati, Ohio, July 10, 1895.

GENERAL: I have the honor to submit the following report in regard to obstructions to navigation, such as bridges, etc., in rivers under my charge, at the close of fiscal year ending June 30, 1895.

* * * * * * *

GUYANDOTTE RIVER, WEST VIRGINIA.

The improvement of low-water navigation of this river has been rendered impracticable for years by reason of the existence of two dams, one known as Peck's, which is about 7 miles below Logan Court-House, and the other one known as Lambert's, distant about 26 miles from Logan Court-House, downstream. These dams project 3½ feet above the bottom of the river, and although they have through them chutes for push boats, they nevertheless seriously interfere with not only that species of navigation but also with ordinary steamboats and the running of logs. Peck's Dam was built before the war and was authorized by the circuit court of the locality. It is claimed that Lambert's Dam

was constructed without any permission or authority whatever. In order that the low-water navigation of this river should be made as complete as possible it is necessary that these two dams should be removed.

As this apparently can not be done with the consent of the owners, I would recommend that they be proceeded against in the United States court as obstructions to navigation, in order to force their removal.

Very respectfully, your obedient servant,

D. W. LOCKWOOD,
Major, Corps of Engineers.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

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(5) REPORT OF MAJ. CLINTON B. SEARS, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Duluth, Minn., June 30, 1895.

GENERAL: Pursuant to the requirements of General Orders No. 9, Headquarters Corps of Engineers, United States Army, June 26, 1888, I have the honor to report as follows:

No piers, breakwaters, or other structures built by the United States in aid of commerce or navigation in this district have been occupied or injured by corporations or individuals during the year, except as indicated in letter to Chief of Engineers June 17, 1895, relative to Marquette Breakwater, as follows:

On the morning of June 3, 1895, the steam propeller *La Salle,* belonging to W. D. Reese, of Cleveland, Ohio, but registering at Marquette, Mich., ran into the breakwater in Marquette Harbor and damaged it.

The break made by the steamer has just been repaired, at a total cost to the United States of $327.76.

* * * * * * *

The collision took place during a heavy fog, but in my opinion it was due to carelessness. The steamer was well in range of the fog signal and consequently the master must have been aware of his general location and the fact that there was a breakwater 3,000 feet long extending out across the harbor, the vessel having been frequently in and out of the harbor, and it was either carelessness or poor navigation that allowed him to bring up against the breakwater. I am of the opinion that he was going too rapidly.*

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Respectfully submitted.

CLINTON B. SEARS,
Major, Corps of Engineers.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

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(6) REPORT OF MAJ. W. L. MARSHALL, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Chicago, Ill., June 30, 1895.

GENERAL: In accordance with General Orders No. 9, Headquarters Corps of Engineers, June 26, 1888, I have the honor to report that I have no information additional to that contained in former reports of

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* Information given to the district attorney, western district of Michigan.

the use, occupation, or injury to piers and breakwaters in this district, which information is required by section 4 of the river and harbor act of August 5, 1886.

The piers and breakwaters in Chicago Harbor are obstructed, occupied, and infested with fishermen, thieves, thugs, and gamblers, as heretofore, and means are sought to rid the piers of their presence. The city of Chicago will police the piers attached to the shore so far as to prevent violations of city ordinances, but will not police piers in deep water disconnected with the shores, nor will they prevent trespassing on any United States piers, but expects the United States to maintain the integrity of its property.

Very respectfully, your obedient servant,

W. L. MARSHALL,
Major, Corps of Engineers.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

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(7) REPORT OF COL. O. M. POE, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Detroit, Mich., July 26, 1895.

GENERAL: In accordance with section 4 of the river and harbor act of August 5, 1886, and General Orders No. 9, Headquarters Corps of Engineers, June 26, 1888, I have the honor to report the following cases where "piers, breakwaters, etc.," under my charge "have been used, occupied, or injured by a corporation or individual" during the fiscal year ending June 30, 1895.

LANDS OCCUPIED BY U. S. LIGHT-HOUSE ESTABLISHMENT.

The United States Light-House Establishment occupies as site for light-keeper's dwelling a portion of the St. Marys Falls Canal grounds, 100 by 200 feet, extending from the south bank of the canal to Canal street, in the city of Sault Ste. Marie, Mich., and just west of the principal meridian of Michigan, the authority for this occupation being a letter of Secretary of War William C. Endicott, dated March 25, 1885, and being terminable at pleasure of the War Department; also, the extreme end of the southwest pier by a light-house, and a portion of the northwest pier by a range light; authority by act of Congress dated March 3, 1879.

The United States Light-House Establishment also occupies the lower and upper ends of the west pier of the St. Clair Flats Ship Canal by light-houses; authority by acts of Congress dated July 28, 1866, and March 3, 1871.

OCCUPANCY OF PUBLIC LANDS, ETC., BELONGING TO THE RESERVATION OF ST. MARYS FALLS CANAL, MICHIGAN.

During the fiscal year ending June 30, 1895, the reservation has been occupied, as reported in my annual report for 1894, printed on page 3191, of the Annual Report of the Chief of Engineers for 1894.

During the fiscal year ending June 30, 1895, portions of the canal piers and grounds have been occupied by the following contractors

connected with deepening the canal, constructing the 800-foot lock and power house and office building, permission having been granted them to do so: Messrs. Dunbar & Sullivan, Hughes Bros. & Bangs, and Joseph V. Gearing. In addition to this privileged occupation, Messrs. Dunbar & Sullivan have occupied a portion of the grounds north of the canal with buildings and shipyard plant used in building dump scows, repair of boats, dredges, etc., without permission and in spite of notification to remove the same.

The ferry steamer *International* also occupied the Government pier in front of old Fort Brady during the greater portion of the season of 1894 as a ferry dock or landing against the orders of the canal authorities not to do so.

INJURIES TO PIERS, ETC., OF ST. MARYS FALLS CANAL, MICHIGAN.

On July 6, 1894, the steamer *Spokane* struck and injured north pier below lock.

On August 10, 1894, schooner *John Keith*, bound down, broke piece out of coping of lock wall with protruding chain plate bolts.

On September 14, 1894, the schooner *James Mowatt* broke piece out of lock wall on north side by scraping it with her chain plate boltheads.

On September 17, 1894, steamer *Onoko*, bound up, struck the north pier at the bridge and damaged it considerably; displaced top stone about 2 inches.

On September 23, 1894, the schooner *Hawgood*, bound up, struck light-house on pier at head of canal, causing considerable damage.

On September 24, 1894, the steamer *Nyanza*, bound up, struck canal pier at section 95, doing damage which cost $179.78 to repair.

On May 2, 1895, the steamer *C. S. Lockwood*, bound up, damaged oak fender on stone sill at west end of lock.

On May 19, 1895, the steamer *Joliet*, bound up, broke piece off of the south wall of lock, on account of the mate refusing to obey orders of Assistant Superintendent McKeone.

On May 24, 1895, the schooner *San Diego* broke a strap on south leaf of upper lock gate.

On June 3, 1895, the steamer *Iron Chief* broke piece out of lock wall in front of canal office.

On June 3, 1895, the schooner *Horner* broke piece off of south wall of lock, about opposite curve in north wall.

On June 15, 1895, the steamer *Spokane* struck pier above lock and damaged it to the amount of $24.

On June 19, 1895, the steamer *Birkenhead* struck her chain plate against wall and broke off piece of coping.

On June 20, 1895, the steamer *J. M. Nichol* chipped lock wall in several places when raising in lock, caused by spike heads projecting from her fender streak.

OCCUPANCY OF PUBLIC LANDS, ETC., BELONGING TO THE RESERVATION OF ST. CLAIR FLATS CANAL, MICHIGAN.

The United States has never supplied the custodian at St. Clair Flats Canal with a dwelling. By tolerance, his son, Subinspector William Mott, has built and occupied a small cottage on the east dike of the canal.

INJURIES TO PIERS, ETC., OF ST. CLAIR FLATS CANAL, MICHIGAN.

On September 23, 1894, the schooner *Mabel Wilson* ran into west pier of canal, doing $28.30 damage.

Very respectfully, your obedient servant,

O. M. POE,
Colonel, Corps of Engineers,
Bvt. Brig. General, U. S A.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

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(8) REPORT OF LIEUT. COL. JARED A. SMITH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Cleveland, Ohio, July 9, 1895.

GENERAL: In compliance with requirements of General Orders No. 9, Headquarters Corps of Engineers, dated June 26, 1888, I have the honor to report that during the fiscal year ending June 30, 1895, the steamer *Siberia*, commanded by Capt. A. W. Morse, while entering harbor of Cleveland, Ohio, about 11.30 p. m., June 23, 1895, ran into the outer end of the west pier, crushing through the waling timbers, piling, and bulkhead.

It is estimated that repairs made necessary by this injury will cost $183.65.

The agents, Messrs. Moore, Barton & Gilchrist, of Cleveland, Ohio, will be requested to make the repairs.

No other information has been obtained regarding the use, occupancy, or injury by a corporation or an individual of any structures or works built or made by the United States in aid of commerce or navigation.

Very respectfully, your obedient servant,

JARED A. SMITH,
Lieut. Col., Corps of Engineers.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

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(9) REPORT OF CAPT. DAN C. KINGMAN, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Oswego, N. Y., July 10, 1895.

The following is the only new case of occupancy of or injury to public works by corporations or individuals in my district during the fiscal year ending June 30, 1895:

Some eight or nine hundred willow trees have been set out by the United States just west of the west jetty at Great Sodus Bay. The object of this was to form a wind-break which would stop the drifting sand and prevent it from being carried into the channel, thereby impairing its navigability. In order to prevent these trees from being injured and destroyed I caused a number of notices to be printed upon cloth and conspicuously posted in their immediate vicinity. These notices set forth the fact that the trees had been planted by the United States

for the protection of its navigable water, and gave the law in the case and the penalty for its violation. Notwithstanding this, it was found in the spring of 1895 that some twenty of the trees had been driven over with wagons and uprooted or broken down. I accordingly secured affidavits from two citizens of Sodus Point, N. Y., that they had seen one Max Cline drive over and break down these trees. These affidavits, together with a full statement of the case, were placed in the hands of the United States attorney for the nothern district of New York. The case was brought to trial before United States Commissioner Getty at Oswego, N. Y. The accused was present and was provided with counsel. The United States attorney appeared in person, but a conviction was not secured.

Respectfully submitted.

DAN C. KINGMAN,
Captain, Corps of Engineers.

APPENDIX A A A.

REPAIR OF THE AQUEDUCT BRIDGE ACROSS POTOMAC RIVER AT WASHINGTON, D. C.

REPORT OF MAJ. CHAS. E. L. B. DAVIS, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1895.

UNITED STATES ENGINEER OFFICE,
Washington, D. C., July 9, 1895.

GENERAL: I have the honor to forward herewith my annual report for the year ending June 30, 1895, for repairs to the Aqueduct Bridge,
* * *

Very respectfully, your obedient servant,

CHAS. E. L. B. DAVIS,
Major, Corps of Engineers.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

Under date of January 23, 1893, a resolution of the United States Senate of January 21, 1893, was referred to this office with instructions to make the examination and report necessary to enable the Secretary of War to comply fully with the resolution. In obedience to these instructions the following report was submitted:

UNITED STATES ENGINEER OFFICE,
Washington, D. C., June 21, 1893.

GENERAL: In compliance with the instructions contained in Department indorsement of January 23, 1893 (915, E. D., 1893), I have the honor to submit the following report of an examination of the piers of the Aqueduct Bridge across the Potomac River at Georgetown, D. C., to comply with Senate resolution of January 21, 1893.

The resolution of the Senate is as follows:

IN THE SENATE OF THE UNITED STATES,
January 21, 1893.

RESOLUTION instructing the Secretary of War to cause an examination to be made of the piers of the Aqueduct Bridge, and the District Commissioners to furnish a statement of expenditures on account of said bridge since it became the joint property of the United States and the District of Columbia.

Whereas by the annual report of the Commissioners of the District of Columbia for the year ending June thirtieth, eighteen hundred and eighty-nine, it is made to appear that the masonry composing the piers of the Aqueduct Bridge was largely in need of repair, and at least one of the piers thereof had settled four inches to the

north, and large cavities caused by erosion existed in more than one of said piers, and that a large sum of money was expended in the repair of the same: Therefore,

Resolved, That the Secretary of War is hereby authorized and directed to cause to be made a thorough examination of the piers of said bridge by some competent officer of the Engineer Corps of the United States Army, and report to Congress at an early day—

First. If any one of said piers of said bridge has so settled as to be out of plumb; and if so, which way it leans.

Second. What cavities, if any, exist in any of the piers of said bridge requiring repairs or in any way impairing the supporting capacity of said piers, or either of them, making specific report of defects, if any, in each pier.

Third. That he transmit a copy of the report of the officer of the Engineer Corps charged with the duty of constructing the piers of the said bridge, showing as minutely as may be the plans and processes used in the construction thereof.

And be it further resolved, That the Commissioners of the District of Columbia be required to transmit to Congress a detailed report of any and all expenses incurred in the repair of the piers of said bridge since the same became the joint property of the United States and the District of Columbia, and by whom said repairs, if any, were made, and under whose direction or supervision the same were made, and, as fully as may be practicable, a detailed account of the work of making the same, and a copy of the report of any officer of the District or employee thereof engaged in the said work, or upon any part thereof, including a statement as to whether the said Commissioners have ever caused either or all of the piers of said bridge to be tested with plumb and level, or any other suitable instrument, to see if either or all of them are out of plumb; and if so, the result of such examination.

Attest:

ANSON G. MCCOOK, *Secretary.*

The examination of the piers of the Aqueduct Bridge called for by the terms of the above resolution required the services of a submarine diver for the examination of that portion of the piers below the level of low tide. At the date of the receipt of the resolution the Potomac River was covered with ice to the thickness of from 12 to 14 inches, and it was then impracticable for a diver to work. Moreover, the water was too cold for efficient work of this character, to which was added the further difficulty that the annual freshets which follow the breaking up of the ice would effectually prevent submarine operations in the early spring. Correspondence was, however, at once instituted with a view to securing the services of a competent and experienced diver, so that the work could be commenced as soon as the season was favorable. A diver was engaged who had laid considerable masonry under water and was experienced in the examination of bridge piers. All the necessary preparations for the work having been made, the examination by the diver was commenced May 2, 1893. A large scow was provided for the use of the diver, the scow being anchored alongside the pier under examination. After about one day's work a heavy rain followed by high northwest winds and a freshet interrupted the work until May 8, 1893, when it was resumed and carried on continuously until May 19, 1893, when the diving was completed. Meanwhile, as the weather permitted, levels were taken at the bridge seats on the top of the piers and measurements made to the end pins of the trusses. The instrumental examination was completed May 20, 1893. The following is a detailed report of the examination.

EXAMINATION OF PIERS AND ABUTMENTS UNDER WATER BY DIVER.

SOUTH ABUTMENT.

The south abutment was found to be riprapped on the river face, below a depth of 7 feet at the west end and 11 feet at the east or downstream end. The masonry was found in excellent condition from low tide down to the riprap.

PIER NO. 1.

Pier No. 1, counting from the south abutment, is the pier which was partly undermined at the west and northwest ends by the flood of June, 1889, and repaired under the direction of the District Commissioners with Portland cement concrete in bags, placed in the eroded cavity by divers. After the concrete was placed, 952 tons of riprap were placed about the pier. The top of this riprap was found, May, 1893, to be about 15 feet below low tide at the west or upstream end of the pier and about 26 feet below low tide at the southeast corner. This riprap prevented any examination of the concrete placed under the west end of the pier. The masonry was, however, found in good condition down to the riprap, with the exception that at the southwest corner the mortar is out of the joints for an area of about 15 square feet. This is not a serious defect, however, and the pier may be regarded as in good condition. A mass of concrete was found at the east end of the pier on which the soundings were from 17 feet in the center to 27 feet at the southeast corner.

PIER NO. 2.

Pier No. 2 was found to be in good condition except a cavity about 1½ feet deep and 2 feet high around the west end. This cavity is between the bed rock, which is quite irregular, and two timbers which are halved together, forming an angle at about the center of the west end of the pier. These timbers rest on the bed rock at their outer ends and may have rested on some loose stones at other points which have since been removed by the action of the current. But it is more probable that the timbers formed a part of the cofferdam and that the foundation course was laid inside the timbers and the next course projecting a little further than the former, covered the upper sides, and that the cavity between them and the rough ledge has always existed.

The bed rock was exposed around the west end and the rest of the pier was surrounded by a bank of sand.

PIER NO. 3.

The greater part of this pier was found in excellent condition, but the foundation courses of the west end have been displaced or eroded, presumably by the action of the current, until a cavity from 3 to 7 feet high and from 3 to 6 feet deep extends all the way around this end of the pier. The bed rock is exposed around the west end, riprap was found nearly all the way along the sides at a depth of about 22 feet below low tide, and a mud bank has formed around the east end, the highest part of which is 15 feet below low tide.

On tracing No. 1 accompanying this report* will be found a sketch of Pier No. 3, showing the position and extent of the erosions as ascertained by the diver.

PIER NO. 4.

A cavity extending nearly the whole length of the south side of this pier was found. This cavity is about 3 feet high above the riprap and 3 feet deep, but as the foundation courses project about 8 feet beyond the side of the main pier the cavity is not as serious a defect as it might appear.

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*Not printed.

There is, however, a large cavity in the west end which starts under the ice breaker at a course about 8 feet below low tide, where it is about 7 feet deep (measured lengthwise of the pier) and extends entirely across the end of the pier. At the southwest corner of the pier the depth of the cavity is 11 feet, or about 4 feet deeper than the average depth. It is probable that the erosion started near the bed rock in the foundation courses, which were worn and displaced by drifting débris, and that as the cavity deepened the stones above fell from their own weight and now lie together with several small trees scattered about the end of the pier. A large tree was found at the bottom lying across the upstream end of the pier, which was probably a factor in the initial erosion of the masonry. The extent of the cavity is shown on the plan and elevations of Pier No. 4, on tracing No. 1 accompanying this report.

There is a crack extending entirely through the pier from the top of the coping down to low tide and probably further, but it was so small that the diver was unable to follow it. This crack is only about three-eighths inch wide at the widest part. The crack is more marked on the south side of the pier than on the north side. The crack is plainly due to the undermining of the upstream end of the pier.

Riprap was found along the sides at a depth of about 25 feet below low tide and a bank of mud 15 feet below low tide at the downstream or east end.

PIER NO. 5.

No serious defects were discovered in this pier. One of the stones in the ice breaker just north of the center and at low tide has started slightly.

There are two places in the foundation courses, one on the southwest and the other on the northwest corner, that need a little concrete to fill rough joints, and some riprap should be placed outside of the concrete for its protection.

There is a large tree lodged at the foot of the west end of the pier, which rests on the bed rock.

Around the east end and sides was found a bank of mud at a depth of about 22 feet below low tide.

PIER NO. 6.

At Pier No. 6 a cavity was found at the northwest corner about 7 feet long, 5½ feet high, and 3 feet deep.

The west end of the pier is founded on quite a steep ridge of ledge, the highest point being near the center of the west end. This ridge has considerable slope toward the sides of the pier, and it may be that this cavity is due to the movement or slipping out of the lower courses on the inclined bed rock. The remainder of the masonry of this pier was found in good condition.

Riprap was found at a depth of about 22 feet at low tide at the downstream part of both sides, which depth gradually increased to 26 feet near the upstream part of the sides. Around the east end is a bank of mud, the highest part of which is 15 feet below low tide.

PIER NO. 7.

There is a stone out of the north side of the pier near the center line and 15 feet below low tide. This stone was about 18 inches square on the face. The masonry is, however, good all around this defect, so that it is not serious.

The rest of the pier is in good condition, except the foundation courses of the west end. These courses have been displaced, leaving a cavity running entirely across the end of the pier. This cavity is about 3 feet high and 2 feet deep at the center, and about 4 feet high and 6 feet deep at the corners.

The bed rock was exposed at the foot of the west end at a depth of 26 feet below low tide. At the east end mud was found at a depth of 22 feet, and riprap along the sides at about 23 feet.

There is a large tree lodged at the foot of the west end of the pier.

PIER NO. 8.

This pier is in good condition, except a few places on the east end and north side, where the mortar is out of the faces of joints, and a small cavity at the foot of the southwest corner, which 7 feet long, 3 feet deep, and 2 feet high.

The bed rock is exposed at the west end, 30 feet below low tide, and riprap was found around the other sides at a depth of from 18 to 30 feet.

NORTH ABUTMENT.

This abutment is in good condition, except a few places where the mortar is out of the faces of the joints. The water is only about 10 feet deep to the mud, which was found around the foot of this abutment.

MASONRY OF PIERS AND ABUTMENTS ABOVE LOW TIDE.

The masonry of piers and abutments above low tide is in good condition, with the exception of the crack already noted on Pier No. 4. All of the masonry above low tide was carefully pointed with Portland cement mortar in 1888, when the bridge was reconstructed, and the pointing was found intact.

LEVELS ON PIERS AND ABUTMENTS.

Levels were taken on bridge seats of all the piers and abutments at the points shown on tracing No. 2.* These bridge seats are of granite, the tops being bush-hammered, 8-cut work, affording good surfaces on which to determine precise elevations of the coping.

These bridge seats were set at a uniform grade of 30 feet above mean low tide of the Potomac River improvement. The levels taken in May, 1893, are given in tabular form below, and show no appreciable variation beyond such as are due to irregularities in the dressing or setting of the stone except upon Pier No. 1. The differences in level found here are due to the movement in the freshet of 1889. Piers Nos. 2 to 8, inclusive, are plumb. Pier No. 1 has moved to the north from the undermining of the freshet of 1889, so that the batter of the north face is now 0.075 foot per foot, and of the south face 0.095 foot per foot. Between the top of the coping and high-tide mark the pier is out of plumb fifty-two one-hundredths of a foot. The pier, however, is in a condition of stable equilibrium, and no serious results need be apprehended from this comparatively slight deviation from the vertical.

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*Not printed.

Table of elevations of bridge seats.

[Letters a, b, c, etc., refer to positions on coping as shown on fig. 2 of sheet No. 2.]

No. of pier.	Elevation at point—							
	a.	b.	c.	d.	e.	f.	g.	h.
South abutment	.....	29.997	.....	30.002	30.002	.....	.....	29.997
1	29.971	29.912	.....	.....	.....	29.938	.....	29.955
2	30.000	.....	.....	30.000	30.011	.....	29.996	.....
3	30.001	29.992	.....	30.001	.....	30.005	29.994	.....
4	.....	29.994	.....	29.999	29.994	.....	30.004	.....
5	.....	29.977	.....	29.998	.....	30.000	.....	30.000
6	.....	30.003	.....	30.003	.....	30.006	.....	.....
7	29.964	.....	29.970	.....	.....	29.990	.....	29.994
8	.....	.....	30.012	30.000	30.003	.....	30.003	.....
North abutment	30.021	30.041	.....	.....	30.021	30.022	.....	.....

MEASUREMENTS OF SPANS.

The measurements taken to the centers of the several piers on the center line of the bridge are shown on sheet No. 2.*

Very respectfully, your obedient servant,

CHAS. E. L. B. DAVIS,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

This report was returned with the request to submit an estimate of cost of making the necessary repairs to the abutments and piers of the bridge, and in reply thereto the following report was submitted:

UNITED STATES ENGINEER OFFICE,
Washington, D. C., July 17, 1893.

GENERAL: I have the honor to submit the following report upon the estimate of cost of the necessary repairs of the piers of the Aqueduct Bridge, in accordance with the first indorsement of the Chief of Engineers' Office, dated June 22, 1893 (inclosure 5 of 915):

Estimate.

Repairs to Piers Nos. 2, 3, 6, 7, and 8; 87 cubic yards Portland cement concrete in bags, laid by a diver, at $30	$2,610
Repairs to Pier No. 4; cofferdam, including pumping and removal	25,450
Shoring old masonry	300
Removing débris, old trees, etc	400
203 cubic yards granite masonry, laid, at $50	10,150
False work for 2 spans	5,500
	44,410
Contingencies, 15 per cent	6,660
Total	51,070

It is proposed to repair Piers Nos. 2, 3, 6, 7, and 8 by means of concrete in bags put in place by a diver.

In the case of Pier No. 4 a cofferdam will be necessary. An estimate is submitted for false work under the panel points of the truss on each side of the pier. In making the examination of this pier in May last there was a very strong current running, making it too hazardous for the diver to go under the overhanging portion of the pier so as to make a thorough examination of the condition of the masonry. The cavity

* Not printed.

was explored by means of a sounding pole inserted at various points with the corresponding amounts of penetration. After the cofferdam is in place and before it is pumped out it is thought that in the still water thus secured a thorough examination of the cavity can be made by the diver, and that such examination may show that only shoring of the old masonry will be necessary. It is best, however, to provide for this false work, as it is very essential not to impede the traffic over the bridge during the repairs, and in case the result of the examination is unfavorable, to relieve the pier entirely of the weight of the superstructure.

While no immediate danger is apprehended, the condition of affairs certainly will not improve, and every high river will tend to scour out these cavities, and it is consequently earnestly recommended that early and liberal appropriation for these repairs be made.

Very respectfully, your obedient servant,

CHAS. E. L. B. DAVIS,
Major, Corps of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A.

In the act of Congress approved August 7, 1894, being

An act making appropriations to provide for the expenses of the government of the District of Columbia for the fiscal year ending June thirtieth, eighteen hundred and ninety-five, and for other purposes,

there was the following item:

For the repair of the Aqueduct Bridge, fifty-one thousand and seventy dollars, said sum to be expended by, and the work to be done under the direction of, the Chief of Engineers of the Army, by contract or otherwise, and by the purchase of material in open market in order to prevent delay in the prosecution of the work.

In the project which was submitted August 21, 1894, it was stated that the damage to Pier No. 4 was so serious that it could not be satisfactorily repaired except by means of a cofferdam, and in order to avoid any danger of accident to the two bridge spans partly supported by this pier it was proposed to build false work to support them during the period of repairs. It was proposed to build the cofferdam on substantially the plan of the one originally used to build the pier by Major Turnbull, to excavate the mud and use clay puddling. The bed of the river being solid rock with a very rough and uneven surface it was thought that special precaution would be needed to form a water-tight joint between the rock and the lower edge of the cofferdam. Before pumping out the dam it was proposed to shore up the overhanging masonry at the ice breaker to prevent it from falling when the buoyant effort of the water was removed. After the dam was pumped out the eroded portions of the pier were to be rebuilt with substantial granite masonry laid in Portland cement mortar and carefully pointed. The cavities in the other defective piers were such that it was thought they could be repaired with Portland cement concrete in bags put in place by a diver. It was proposed to do this work by means of hired labor and purchase of material in open market. This method of construction being approved by the Chief of Engineers, a raft was built and accurate soundings were taken around the pier with pole and iron pointed rod to determine the character of the bottom. This examination revealed the fact that the bottom was very irregular and rocky, with but very little overlying material, and that chiefly on the down-stream side. This scouring away of the overlying material was probably

caused by the restriction of the waterway due to building the piers of the bridge. At the time of this examination it was thought that a great deal of riprap stone must have been deposited around the pier, as otherwise it was difficult to account for the great irregularity of the bottom. The subsequent examination, after the dam had been pumped out and the pier exposed, showed that this great irregularity reported by the diver and revealed by this examination was due to exceedingly poor masonry construction.

During this examination correspondence was opened with firms engaged in foundation work, giving an outline of the work and its character and asking them, after further investigation and examination, to submit proposals either for the entire work or any part of it. This was done because it was found that a large and expensive plant would have to be purchased or hired, consisting of pile drivers, pumps of large capacity and in duplicate in case of accident, barges, tugs, etc., which would take time to collect and might be left on hand after the completion of the work. It was thought it would expedite matters if firms engaged in this class of business should be found willing to undertake the work at reasonable figures. The following firms were written to: Anderson & Barr, of New York; McLean Submarine Construction and Wrecking Company, of New York; Sooysmith & Co., of New York, and the Wakefield Sheet Piling Company, of Chicago, Ill. The Shailer & Schniglau Company, of Chicago, having heard of the correspondence through the Wakefield Company, wrote for information.

Anderson & Barr declined to bid. No reply was received from the McLean Company. Sooysmith & Co. sent one of their engineers to make a personal examination, and Mr. Shailer himself came for the same purpose. The Wakefield Company wrote that they would send Mr. Wakefield to superintend if the Government would furnish material and labor.

Two written proposals were received, one from the Shailer & Schniglau Company and the other from Sooysmith & Co. These proposals being classified appear as follows:

No.	Name and address of bidder.	Shoring up trusses and building and pumping out cofferdam at Pier No. 4.	Laying masonry, Pier No. 4.		Putting in concrete, Piers Nos. 2, 3, 6, 7, and 8.		Removal of cofferdam.	Total.
			Per cubic yard.	For 203 cubic yards.	Per cubic yard.	For 87 cubic yards.		
1	Shailer & Schniglau Co., Chicago, Ill.*	$24,000	$30	$6,090	$25	$2,175	$1,500	$33,765
2	Sooysmith & Co., New York, N. Y.†	.....	.....	.....	.....	.....	.....	‡47,000

*Commence as soon as notified of acceptance of bid; complete January 31, 1895. Use timber crib 18 feet wide, with Wakefield's patent triple-lap sheet piling along outside edges.

†Commence as soon as notified of acceptance of bid; complete January 1, 1895. Propose to use pneumatic caisson, surmounted by crib filled with concrete; caisson sunk to rock; masonry commenced on crib 2 feet below low water.

‡Will support the spans now resting upon Pier No. 4, remove pier, and build new one complete, also repair other piers, all for above sum.

As will be seen from the footnotes, one proposed a pneumatic caisson and the other a cofferdam, the former requiring the entire removal of the pier and its reconstruction and the latter the exposure of the masonry and the repair of the defective portion. The bid of the Shailer & Schniglau Company being the lowest and reasonable its acceptance was recommended. The act authorizing the repairs specified that the work was to be done "by contract or otherwise, and by purchase of material in open market, in order to prevent delay in the prosecution

of the work." Under other circumstances it would have been recommended to publicly advertise for proposals in order to secure greater competition, but it was thought the delay arising from such a course would make the risks of winter ice and spring freshets greater. The recommendation having been approved the contractors were notified by wire of the acceptance of their bid September 26, 1894, and immediate steps were taken for the prompt commencement of the work. The contract provided for the repair of all the defective piers. Pier No. 4 was to be repaired by means of a crib cofferdam consisting of a heavy timber crib filled with stone surrounding the entire pier and made water-tight by means of Wakefield triple-lap sheet piling driven around the outside of the crib and down to the rock bed of the river. The ends of the two iron trusses resting on the pier were to be supported by trestlework so as to be independent of the pier, to insure immunity from any accident during the progress of the repairs. Before pumping out the dam the overhanging masonry of the ice breaker of the pier was to be shored up by a diver to prevent the possibility of the fall of any part of it when the buoyant effort of the water was removed. The dam was then to be pumped out and kept dry and the defective masonry removed and replaced by new masonry laid in cement mortar. After the new masonry was completed and had had time to set the dam was to be filled with water and then removed. The remaining eroded piers needed comparatively slight repairs, which were to be made with rich Portland cement concrete put in place by a diver.

As the difficulties attending the prosecution of this work have been very numerous, with one serious break in the cofferdam, fortunately with injury to no one employed on the work, it is thought best to give the journal of operations for each month since the inception of the work to the end of the fiscal year so as to present the difficulties and mishaps in their regular and proper sequence.

OCTOBER, 1894.

The repairs to Piers Nos. 2, 3, 5, 6, 7, and 8 of the Aqueduct Bridge were commenced by the contractors, the Shailer & Schniglau Company, of Chicago, on October 18, 1894, and continued through the remainder of the month. The repairs to these piers are made by means of concrete, which is mixed, put in bags, and then placed in position by a diver. The eroded cavities were found to have increased in size since the examination of May, 1893, and the amount of concrete required is in most cases greater than has been estimated.

Work was begun on Pier No. 2 and continued successively at Nos. 3, 5, and 7. At Pier No. 3 the cavity was so deep that it was necessary to shore up the overhanging masonry with struts of Georgia pine timber before putting the concrete in place. The work was carried on fourteen days and 111 cubic yards of concrete were put in place. The work of building a crib cofferdam for Pier No. 4 was commenced with all the available timber to be had in this market. The bottom courses for each of the eight cribs which are to form the lower part of the cofferdam were finished during the month, and this part of the work must now await the arrival of the timber to be shipped from Georgia.

NOVEMBER.

The repairs to Piers Nos. 2, 3, 6, 7, and 8 by means of concrete in bags put in place by a diver were continued by the contractors and were completed November 30, 1894. The largest cavity was found at Pier

No. 3, and this had evidently increased in size since the examination of 1893. Eighty-nine and one-tenth cubic yards of concrete were required to make this pier secure. At Pier No. 6, in addition to the cavities found in 1893, the masonry at the southwest corner of the pier had been carried away, probably by the action of masses of ice, and extended repairs were required here, the amount of concrete laid being 57.7 cubic yards. The concrete was examined by an inspecting diver employed for the purpose, who reported the work as entirely satisfactory. This diver also made a complete examination of each of the above piers and found a few small additional cavities, which were promptly filled with concrete by the contractors. The total amount of concrete put in place in these six piers was 194.6 cubic yards, distributed as follows:

	Cubic yards.
Pier No. 2	18.9
Pier No. 3	89.1
Pier No. 5	3.6
Pier No. 6	57.7
Pier No. 7	19.6
Pier No. 8	5.7
Total	194.6

On November 17, 1894, the eight cribs forming the lower part of the cofferdam were towed to Pier No. 4 and put in position around it. The cribs were next secured together by overlying courses of timber, drift-bolted and framed in accordance with the plans, and the floor put in place in the pockets which are to be filled with riprap. At the close of the month about one-third of the height of the crib had been built. This branch of the work has still been delayed by the nonarrival of the cargo of timber which was due November 15, but which had not reached this port on November 30. In the meantime, however, some shipments have been made by rail, so that substantial progress has been made with the construction of the cofferdam.

At Pier No. 5 several large trees and snags were found lying on the bed of the river and lodged across the upstream end of the pier. These were removed by hired labor. At Pier No. 8 a timber was found belonging to the cofferdam in which the pier was built in 1839. The timber was partly afloat, being held at one end, and was sawed off by the diver. It was 27 feet long and 16 inches square. The sides were water-worn, but the timber was in a perfect state of preservation after having been under water for fifty-five years.

DECEMBER.

On November 30, 1894, the repairs to Piers Nos. 2, 3, 5, 6, 7, and 8 by means of concrete, put in place by a diver, had been completed. As this concrete was placed almost entirely at the upstream end of the piers it was deemed advisable to protect it from the action of ice and freshet currents by means of riprap stone. Proposals for stone having been invited, it was purchased of the lowest bidder, Mr. E. G. Gummel, of Eckington, D. C., at 63 cents per cubic yard, delivered on board scows at the bridge. The stone was thrown in place by hired labor. This work was commenced December 1, 1894, and completed December 28, 1894. Two thousand and fifty cubic yards of stone were used, and an examination by a diver shows that the concrete is fully protected. The repairs to Piers Nos. 2, 3, 5, 6, 7, and 8 are, therefore, reported as complete.

The construction of the crib cofferdam at Pier No. 4 by contract was delayed during the early part of the month for want of lumber. The cargo of timber ordered by the contractors for this work arrived, however, on December 11, 1894, when operations were promptly resumed. The walls of the crib were built up and the pockets loaded with riprap until the crib rested on the bed of the river, except at the northeast corner, where it was caught on some projecting points of rock which had not been detected by the contractors when taking their soundings. The timbers of the crib resting on the projecting points were partly cut away by a diver, and some further sinking of this corner of the crib thus secured. There is, however, some deflection in consequence in the north wall of the crib, but this part of the crib has been blocked up at the bed of the river by the diver, and it is thought that with suitable precautions a tight dam will be secured. The making of sheet piles was commenced as soon as the lumber arrived, and about two-thirds of those required have been made.

On December 29, 1894, the river was practically closed by ice, which, together with the extreme cold, has since delayed the progress of the work.

JANUARY, 1895.

Work on the cofferdam for the repair of Pier No. 4 has been continued whenever the weather would permit. The sheet piling has been driven entirely around the crib, except for a space of about 4 feet on the north side, which will be closed when the dam is ready to be pumped out. The piles are Wakefield sheet piles, from 26 to 36 feet long, and were driven down to solid rock. They are made of three thicknesses of 2-inch planking 12 inches wide, bolted together, with a 3½-inch tongue and groove. Some shoring was done by the diver under the overhanging part of the ice breaker of the pier. The north side of the crib was also blocked up from the bed of the river so as to give a firm support for the trestle piers of the false work.

The north trestle tower of the false work, which is to support the ends of the spans resting on Pier No. 4 during the repairs, has been erected. The cutting of the stone at the quarries has been continued.

A slight freshet occurred January 11, which removed the ice then in the river without any damage to the cofferdam. The work was delayed five days by storms and freshets.

FEBRUARY.

Work on the cofferdam and trestle towers at Pier No. 4 was continued during the early part of February. Owing to the stormy weather, snow, and extreme cold operations could be carried on only with the greatest difficulty. The river was completely closed by ice, which reached a thickness above the bridge of about 11 inches. As it was impracticable to continue the work under the existing conditions, the contractors requested permission to suspend operations until the ice was out of the river. The request was approved February 13, 1895, and as a precaution against loss or damage from possible ice freshets the plant was placed on scows and the north tower was taken down. A temporary fence was built on the roadway between Piers Nos. 3 and 5 in order that travel over the two spans resting on Pier No. 4 might be confined to the east side of the roadway when necessary during the progress of the work. At the close of the month this part of the river had been practically cleared of ice, and the indications were favorable to an early resumption of work.

MARCH.

The weather and the stage of the river having become favorable, work was resumed at the cofferdam about Pier No. 4 on March 6, 1895. The trestle towers of the false work were first erected on the crib, and the wooden trusses which transmit the weight of the bridge to the towers were next put in position. The wrought-iron girders on top of the pier constituting the cantilever, which had been put in as a temporary support for the west trusses, were next removed. When the removal of the cantilevers commenced the west side of the bridge between Piers Nos. 3 and 5 was closed to travel in order that the least possible weight might come upon the defective (or west) part of Pier No. 4. As soon as the cantilevers had been removed the iron stirrup rods which were to carry the weight of the bridge from the end pins of the trusses to the apex of the triangular wooden trusses were put in place and the weight of the bridge then gradually taken up on the false work by turning up the nuts on the screw ends of the stirrup rods. During the last two operations the entire weight of the bridge rested on the pier without any further opening of the crack or other bad results. In the meantime clay puddling had been thrown in around the outside of the dam so as to form a tight joint between the sheet piling and the rock bed of the river. A boiler and an 8-inch centrifugal pump having been put in place on the top of the crib, the small opening which had been left during the driving of the sheet piling was closed. Pumping was then commenced slowly in order to test the dam and bring a slight pressure on the outside in order to tighten it. Several leaks were found at first, but these were soon stopped by the diver.

It was found by the contractors that it would be necessary to put in all the shores before pumping out the dam to any considerable depth, and this work was being done by the diver at the close of the month. The boiler first installed was found to have insufficient steaming capacity, and the contractors have purchased a second boiler. The interior of the dam has been pumped out to a depth of 8 feet below low tide, exposing the upper part of the eroded cavity, but the dam afterwards filled.

APRIL.

The contractors have continued operations on the cofferdam for the repair of Pier No. 4, but no substantial results have been attained, the work being no nearer completion than it was on March 31, 1895, the date up to which the last report was made. From April 1 to 5, 1895, the contractors had a diver engaged in placing shores between the lower part of the crib and the pier. This work was necessary because the contractors have only placed enough riprap in the crib to sink it, and not being filled with riprap, it has no special weight and therefore no inherent stability by which to resist the pressure of the water without shoring to the pier on all sides. The boiler first put in service was found to give an insufficient steam supply, and a new 40-horsepower boiler was installed April 3. Pumping was commenced April 6, 1895, the water at first being lowered only fast enough to allow shores to be put in. On April 9 the dam had been pumped down to a depth of 12 feet below low tide, but on the following day, April 10, the pump got out of order and the dam filled. Pumping having been resumed, a depth of 6 feet was reached April 14, when the pump again got out of order and the dam filled. The contractors at first proposed and tried

to do all the pumping with an 8-inch centrifugal pump, but this was soon found entirely insufficient, and on April 16 a new 10-inch Worthington duplex pump was put in place, being set down inside the dam about 4 feet below low tide. This pump having been put in operation, a depth of 12 feet was reached on April 17, when a large leak occurred in the west end, filling the dam for the third time. The leak continued all the next day, April 18. On April 19 pumping was resumed and a depth of 11 feet was reached, but the dam then sprung a leak at the west end and filled for the fourth time. April 20 was spent in repairing leaks with a diver, no pumping being done. Pumping was resumed on April 21 and continued until April 24, a depth of 19½ feet below low tide had been reached. At this level the bottom showed on the inside of the dam at the northeast corner, agreeing with the soundings taken by this office in September, 1894. On the same day a serious leak occurred at the southwest corner of the dam, which was checked somewhat but not stopped. The pumping was continued and the same level preserved through two high tides, each of which increased the head 3 feet (the leak, meanwhile, gradually increasing) until 2 p. m. on April 24, when the sheet piling broke and the water burst through the dam with great violence, the sudden inrush of water being so great as to completely fill the dam in 10 minutes. So great was the force of the water that the silt 10 feet in depth was washed away from the sheet piling on the inside and churned into black foam as it rose to the surface. The break occurred at the bent at the extreme southwest corner of the dam. This bent is 9 feet long, and a number of sheet piles along its face were broken and forced in by the pressure of the water, due to the head of 19½ feet. The sheet piling here had been carelessly driven, the joints being open and the piles somewhat split. The contractors did not sink the crib through the bed of silt to the solid rock, but allowed it to rest in the upper part of the silt stratum about 6 or 8 feet above the rock. Outside of the crib the triple sheet piling were driven to the rock, but under the conditions noted yielded under the pressure and the dam failed.

The original time for the completion of the contract was January 31, 1895. The time has been extended to June 1, 1895.

MAY.

Work on the cofferdam at Pier No. 4 was continued. From May 1 to 20 the contractors were engaged in strengthening the west or upstream end of the cofferdam, where the break occurred in April last. An additional row of Wakefield sheet piling 6 inches thick was driven outside the original sheet piling along the west end and for a short distance along the adjacent portions of the north and south sides of the dam. This additional sheet piling was driven with great care, a diver being kept under water near the bottom of the river to direct the piles as they were driven and secure tight and close joints. Additional riprap was also placed in the crib at the west end for a depth of 4 or 5 feet above the bottom. The repairs to the dam having been completed, pumping was resumed May 20 and continued cautiously until May 29 at 3 p. m., when a level of 22½ feet below low tide was reached, exposing the mud overlying the rock bed of the river and showing the whole of the eroded cavity. This cavity was found to be about 25 feet wide at the bottom, 19 feet high, and 12 feet deep, the depth being measured in the direction of the length of the pier. Besides the large cavity in the west end of the pier, the sides of the footing were found to be undermined.

from 3 to 4 feet for much of their length. The cross shores or braces in the original cofferdam of 1838 had been left in place and built into the masonry of the pier. They have proved a source of weakness, for it was found that the masonry near the eroded cavity had cracked seriously along the westerly line of shores. The masonry of the old pier below low-tide level was found to be of an exceedingly poor quality, the stones having been apparently laid as they came from the quarry, with little attention to shaping or proper beds, and it is not surprising that the masonry was eroded by the freshet currents. The granite ice breaker had been supported during the pumping out of the dam by heavy wooden struts put in place by a diver. It was found that the difficulty of supporting this overhanging masonry and the danger and difficulty of building up under it would be so great that it was deemed advisable to take it down before commencing the new masonry. This work will be the next undertaken. At the close of the month the dam was still held at the depth of 22½ feet below low tide, a pump being kept in slow operation to pump out the leakage, which is estimated at 600 gallons per minute.

JUNE.

The repairs to Pier No. 4 under contract of the Shailer & Schniglau Company were continued. The contract provided that the cofferdam should be pumped out and kept dry for five days before the first payment of two-thirds the contract price for the same should be made. On June 1 this test was in progress and on June 3 it was satisfactorily completed. Since then the dam has remained in good condition, the leakage being uniform and easily handled by the pump. Much of the water comes from springs in fissures in the rock, which yield clear water when the river is turbid, while one of the springs is a sulphur spring.

The overhanging masonry of the ice breaker was removed in order that the reconstruction of this part of the pier might be safely prosecuted. This masonry, which was just above the eroded cavity, was found to be well laid in lime mortar and was removed with some difficulty, the work having been completed June 15. The removal of the débris below the eroded cavity was next undertaken, the excavation being carried down to solid rock and as far down stream as the first line of cross braces of the original cofferdam of 1838, which timbers, 21 in number, had been left in place and built into the masonry of the pier. As this work went on an unexpected and surprising discovery was made. It was found that the old masonry had not been started from solid rock, as shown on the original plans, but upon riprap stone apparently thrown in without removing the débris upon the rock. Layers of mud and sand were found under the lowest of the old shores, while lying on the rock diagonally under the masonry of the pier an old tree was found, which must have been there before the pier was built. For some 12 feet above this insecure foundation the masonry is of the poorest quality possible and hardly worthy of the name of masonry. The stones were apparently put in as they came from the quarry, without the slightest reference to beds, being set on end, edge, and in every conceivable manner, while few if any traces of mortar or cementing material are found. As the level of low tide is approached, however, the quality of the masonry improved, and from a level about 6 feet below low tide up to the top of the pier the masonry, while rough in appearance, is strong and is fairly good quality of rubble masonry.

The Acting Secretary of War and the Chief of Engineers made an inspection of the pier on June 24, 1895, and in view of the poor quality of the masonry at the base of the pier it was decided that after the completion of the present contract (for the upstream end of the pier) it would be necessary in the near future to remove the defective masonry in the remainder of the pier and replace it by masonry of proper quality founded on the solid rock. The existing appropriation will be insufficient for this purpose, and it will therefore be necessary to ask a further appropriation from Congress. The cofferdam will be needed for the proposed work, and the contract has therefore been modified so as to provide for the purchase of the cofferdam from the contractors for the sum of $3,000 in lieu of its removal by them, for which last they were to be paid $1,500 and were to have the timber.

In order to excavate to and start the foundation of the new work on solid rock it was found necessary to build an inner dam of sheet piling 3 inches thick around the foundation area of the west end of the pier. This dam reached to a level some 6 feet below that drained by the large pump, and a steam syphon was used to keep it clear. This small dam broke in several times from the pressure of the water, but was held on June 20 so that the excavation could be carried down to solid rock, and on June 30 this excavation had been practically completed. The lowest level of the bed rock was 31 feet below low tide, and this had probably never been before exposed. Sand, mud, logs, and loose stone were found overlying the rock. The bed rock was found to be very irregular and covered with small projecting spurs or nodules, with corresponding depressions or valleys. The general level of the rock plateau uncovered was about 24 feet below low tide, but at the extreme upstream end of the base of the pier as it is to be rebuilt a deep cavity was found, curving under the overhanging shelf of rock and forming a small cave, the lowest part of the cavity being, as stated, about 31 feet below low tide.

FUTURE OPERATIONS.

It is expected that the eroded portions of Pier No. 4, which have all been removed, will be replaced by new masonry, and the repairs completed as far as can be done under the present contract soon after the close of the fiscal year, when the dam will be allowed to fill and put in condition to withstand the winter ice and spring freshets.

A project for removing all of the remaining defective parts of the pier will be prepared, with estimate of cost, with a recommendation for a further appropriation by Congress sufficient to completely and satisfactorily repair the pier.

Money statement.

Amount appropriated by District of Columbia appropriation act of August 7, 1894		$51,070.00
June 30, 1895, amount expended during fiscal year		27,282.03
July 1, 1895, balance unexpended		23,787.97
July 1, 1895, outstanding liabilities	$457.00	
July 1, 1895, amount covered by uncompleted contracts	15,590.00	
		16,047.00
July 1, 1895, balance available		7,740.97

APPENDIX B B B.

WASHINGTON AQUEDUCT—INCREASING THE WATER SUPPLY OF WASHINGTON, DISTRICT OF COLUMBIA—ERECTION OF FISHWAYS AT GREAT FALLS.

REPORT OF MAJ. JOHN G. D. KNIGHT, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1895.

1. Washington Aqueduct.
2. Increasing the water supply of Washington, D. C.
3. Erection of fishways at Great Falls.

OFFICE OF THE WASHINGTON AQUEDUCT,
Washington, D. C., July 12, 1895.

GENERAL: I have the honor to transmit herewith report of operations for the following works in my charge for the fiscal year ending June 30, 1895, viz: Washington Aqueduct; increasing the water supply of Washington, D. C.; erection of fishways at Great Falls.

Very respectfully, your obedient servant,

JOHN G. D. KNIGHT,
Major, Corps of Engineers.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

B B B 1.

WASHINGTON AQUEDUCT.

Appropriations for the Washington Aqueduct are applied to the improvement, the maintenance, and repair of those portions of the Washington water supply, other than the tunnel from the distributing reservoir to the new reservoir near Howard University, that have been placed under the supervision of the Chief of Engineers. The works include the masonry dam, 2,877 feet long, extending from the Maryland to the Virginia shore at Great Falls of the Potomac, 14 miles west of Washington; the works at Great Falls for regulating the supply of the conduit; the conduit from Great Falls 9 feet in diameter; the three reservoirs, viz, the Dalecarlia receiving reservoir, about 4½ miles west of the city, the distributing reservoir, about 2 miles west of the city, and the high-service reservoir in Georgetown for the supply of the higher portions of the city; the mains by which the water is carried from the reservoirs and delivered into the city's distributing system and the bridges for supporting the mains across Rock Creek.

The following statement exhibits the condition of the Aqueduct and its accessory works and the operations of the last fiscal year:

THE DAM AND OTHER WORKS AT GREAT FALLS.

Deposits of mud were removed from the mouth of the conduit, and in the winter this mouth and its screen were protected from damage which might have been occasioned by ice and high water.

By act approved August 7, 1894 (Public No. 171), $5,000 was appropriated for protecting the conduit at wasteweir numbered 1, near Great Falls. The masonry at this weir, which is at the mouth of an outlet from the side of Tunnel No. 1, had never been completed, and consequently the head of water in the conduit could not always be maintained as high as necessary. The mouth of the outlet needed also a protection in the form of a heavy iron grating against the indraft of logs and other driftwood into the conduit in freshets.

The crest of the weir was at reference 149, and stop planks 1 foot high could be set on this. At reference 150 water would flow freely from this outlet.

The project for this work was submitted March 7, 1895, and having been approved was executed by the end of the fiscal year. The necessary stone was taken from the Government quarry near Seneca and the masonry work executed by day labor. As completed the crest of the weir is at reference 150 for a length of 31 feet, and stop planks 1 foot high can be placed on this crest, and at reference 149 for 10 feet, with provision for stop planks 2 feet high. The intermediate piers and end walls are carried up to reference 155 feet 6 inches and the openings protected by heavy iron gratings, which will swing outward but not inward. The total cost of this work was $3,042.41.

A system of marking the flood lines in the gorge of the Potomac just below Great Falls was commenced, and the flood lines of 1889 and 1894 were marked by brass plates stamped with the dates of the floods and strongly bolted to rock.

A combined storehouse and stable is needed at Great Falls, which may be built from the appropriation for the Washington Aqueduct for the next fiscal year.

An estimate for the protection of the inlet to the Aqueduct will be found in the list of estimates and an explanation of the same, under the title "Explanations of estimates," further on in this report.

THE RESERVOIRS.

The improvement of the Dalecarlia receiving reservoir is under the supervision of Col. George H. Elliot, Corps of Engineers, retired.

The water of this reservoir was thrown out of service in the spring of 1888.

A drain 820 feet long was laid from the valve chamber at the distributing reservoir to the Chesapeake and Ohio Canal. Eight-inch iron pipes were used for this purpose, this pipe being on hand, having been purchased for the work of increasing the water supply of the city.

A few linden trees, obtained from the Commissioners of the District of Columbia, were planted along the Conduit road at this reservoir.

Water can not be drawn from this reservoir below reference 135, and the reference of the flow line is 146 feet above datum, a difference of level equal to 11 feet, corresponding to a storage of 150,850,000 gallons.

During the different months of the year, not considering occasions when the water was lowered by the supply from the conduit being cut

off for purposes of repairs or of removing deposits in the conduit, the level of the water fluctuated as follows:

Month.	Lowest.	Highest.	Month.	Lowest.	Highest.
1894.			1895.		
July	143.85	144.30	January	142.85	145.20
August	143.95	144.89	February	141.45	144.40
September	144.80	145.15	March	142.10	145.55
October	143.60	144.85	April	144.00	145.35
November	144.15	144.95	May	143.30	145.45
December	143.50	145.20	June	143.10	145.15

The following extract is from the Annual Report of this office for the year ending June 30, 1890 (Report of the Chief of Engineers, U. S. Army, 1890, p. 3524):

> It will be seen that while formerly the water in the service pipes on East Capitol street on Capitol Hill rose to a height of from 100 to 103½ feet above datum, the water in the distributing reservoir standing at 146 feet, it was found at the end of the fiscal year just passed that it rose to a height of from 126½ feet to 130 feet above datum, the water in the distributing reservoir standing at 145 feet above that plane, so that it may be stated in general terms that the water on Capitol Hill, excepting when its free flow is obstructed by the insufficient size or the internal corrosions of street mains and service pipes, stands about 30 feet higher than before it had the new supply.

The table given above shows that during the past year the water in the distributing reservoir has been at levels not far below 145 feet and at times even above 145 feet; therefore any material reduction of head in the city service below the level reported in 1890 is not to be attributed to low levels of water in the reservoir.

The raising of the height of the dam at Great Falls will increase the discharge of the conduit and will thus provide for an increased consumption, but a material increase in the level of the water in the distributing reservoir is not contemplated, for such increase would cause the water to flow over the banks.

Hence, while provision will be made for increased consumption, additional pressure in the existing low-service mains will not result from any work now authorized by Congress.

It follows that there is imperative need of early action by that body if increased pressure in the water mains of this city is to be effected.

Recommendations as to how this improvement may be effected are deferred for presentation with the report on the feasibility and propriety of completing the tunnel conduit which is to be submitted to Congress next December, as required by an act approved March 2, 1895.

THE CONDUIT AND THE CONDUIT ROAD.

Extensive repairs were made to the Conduit road from Great Falls for a distance of about 2½ miles; general repairs to the rest of the road, ditches cleaned, deposits removed from culverts, fences repaired and whitewashed; a part of the road east of the Dalecarlia reservoir was widened; a new iron door placed at wasteweir numbered 3; two sections of fence constructed at and near this weir.

Manholes 2 to 54, inclusive, were uncovered and examined to see if their brick linings were below the hydraulic grade line; those of manholes 31 to 54, inclusive, were found to be below this line and were raised.

By act approved March 2, 1895 (Public No. 109), $14,000 was appropriated for removing the accumulation of deposits in the conduit.

The project for executing this work was submitted March 13, 1895, and approved. It contemplated occasionally putting down stop planks, then almost emptying the conduit; loosening the deposits by sending laborers in the conduit equipped with lanterns, hoes, and shovels; then sluicing out the loosened material and again filling the conduit and the reservoir.

This work can only be carried on when the river is high and, owing to the limited available storage, for not more than twenty-four hours, of which only eight, as a rule, can be devoted to the actual labor of loosening deposits. The remaining hours are required for emptying, filling, and sluicing the conduit.

The work was carried on March 17, April 26, and May 17 in the by-conduit around the Dalecarlia reservoir and in about 6,070 feet of the main conduit, a short section of this distance being from and above the north connection of the receiving reservoir. The conduit was not thoroughly cleaned for the distance stated, but much mud was carried away by the water which continued flowing in the conduit for a depth of 18 to 24 inches. It remains to be seen whether this method of cleaning the conduit will be effective throughout the 9 miles of conduit between the gates of the walls of wasteweirs 1 and 2. It may be found necessary to carry the deposits to some of the manholes, of which there are 54 on this section, and remove it through these. This more expensive method will not be tried until the failure of the other is demonstrated.

As was to be expected, the heavier deposits are to be found below the gates in wier walls and in enlargements of the conduit, as at gate chambers, and when unlined sections of tunnels are below lined sections of lesser area. In the tunnel just below wasteweir 2 a deposit of mud 3 feet deep for a length of 100 feet was reported, while immediately above the weir none was found; farther above deposits varied from 8 to 10 inches in depth.

The cost of the work so far executed is but $487.73.

The floor of the south connection of the receiving reservoir was repaired. There was extensive leakage through this floor into this reservoir, and the water thus escaping was lost, as the reservoir is not in use for the present. The flat paving blocks under the stop planks were found to be entirely loose and resting on rotten rock. They were taken up, the rock excavated, and a concrete curb about 4 feet wide and as many deep was built across the opening under the stop planks, the bottom plank having been set for nearly its whole depth in this concrete.

THE MAINS.

The trunk mains that lead from the distributing reservoir and supply the distributing system of street mains were laid by the United States and are under the care of this office. The aggregate length of these mains is about 21 miles. The distributing mains were laid by the District of Columbia and are under the care of the Commissioners of the District.

Section 1803, Revised Statutes, forbids the tapping of any main laid by the United States in the District of Columbia except by permission of the Chief of Engineers, United States Army.

September 21, 1894, the Commissioners of the District of Columbia addressed a letter to the Secretary of War, requesting to be furnished with a list of the water mains which come within the purview of this section. This letter having been referred to the Chief of Engineers,

was by him referred to this office and returned with a report dated December 31, 1894, Appendix 3.* In returning this report the Chief of Engineers concurred in so much of the following recommendations of this office, which were then approved by the Secretary of War:

1. That general authority be granted to the Commissioners of the District of Columbia to tap all the United States mains in the District of 12 inches in diameter and under at their pleasure, with the exception of the 10-inch main in Georgetown between its valve just north of M street and the Rock Creek Aqueduct Bridge at Pennsylvania avenue; the 12-inch main on the Conduit road between the distributing reservoir and Foxall Hill, and the 12-inch main on the Canal road.

2. That the Commissioners of the District of Columbia be requested to lay a distributing main on the Conduit and Canal roads between the distributing reservoir and the foot of M street at the Aqueduct (Arlington) Bridge, and that, if this main be laid and it be requested by them, permission be granted to the Commissioners to tap the 12-inch main for the supply of this distributing main.

Permission was given by the Chief of Engineers to the Commissioners of the District to tap the 12-inch main in the Conduit road at Elliot Place for a 6-inch main connection; and to private parties to tap the 30-inch main in K street for service connections not exceeding 1 inch in diameter, for premises Nos. 1419, 1527, 1721, and 2007.

January 22 at 1 a. m. a bad break due to defective iron occurred in the 24-inch main at K and Third streets NE. The broken pipe was replaced by a new length by 8 p. m. the same day.

Small leaks were repaired as follows: At joints of the 48-inch main; one, 27 feet east of east curb of Potomac street; two in M street; and one, just west of west curb of Thirty-second street; and at joint of 30-inch main at New Jersey avenue and K street.

New covers were placed on manholes at Thirty-second and M streets and at New Jersey avenue and D street; and casings of manholes were raised near Dupont Circle and at Eleventh and U streets. The manhole over the old hydraulic ram in the west abutment of Rock Creek Bridge was closed up.

The main, blow-off, air, and vacuum valves were examined and worked monthly, and repairs made at Thirty-second and M streets to a 3-inch vacuum valve and to air valves at College Pond and Rock Creek.

An estimate for inserting efficient air valves and blow-off valves in the old 30-inch and 36-inch mains will be found in the list of estimates, and explanations of the same will be found farther on in this report under the title "Explanations of estimates."

THE BRIDGES.

Five thousand dollars was appropriated by act approved August 7, 1894, for repaving Griffiths Park and Cabin John bridges. These bridges were repaved with vitrified bricks, costing $24 per thousand. The total cost of repairs was $2,834.98.

Repairs have been made to the bridge across the spillway of the Dalecarlia reservoir and to the Pennsylvania Avenue Aqueduct Bridge across Rock Creek; and lumber has been purchased for further extensive repairs to the former bridge and for reflooring the roadway of the latter.

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* See page 4119.

The experience of the past nine years is that reflooring the Rock Creek Bridge is necessary every three years, whether the lumber used be oak or Georgia pine.

THE AQUEDUCT LANDS.

During the fiscal year next preceding this, surveys of the Aqueduct lands were extended to Griffith's Park Bridge (Bridge No. 3). During the past year these surveys were extended 3 miles and about 400 feet. Boundary lines were located and corners marked with boundary stones properly marked and numbered.

A report was made February 20, 1895, of encroachments on Aqueduct lands between Bridge No. 3 and the clubhouse, where the conduit and the road leading to Great Falls separate, and also the encroachment of fences between that house and Cabin John Bridge. This with previous reports of November 5, 1890, and April 12, 1894, is thought to cover all encroachments on the Aqueduct lands pertaining to the conduit.

An act approved January 26, 1895 (Private No. 19), authorized the sale of title of United States to a tract of land in Montgomery County, in the State of Maryland, to William H. and George Bobinger, at a price to be determined by the Secretary of War. The price determined was $100, which sum having been paid by the parties named, a deed was executed by the Secretary of War and delivered to them. The sum paid has been deposited in the United States Treasury.

February 15, 1895, this office recommended that a bill be submitted to Congress authorizing the sale of title of United States to certain tracts of land in the District of Columbia to Margaret Shugrue and Caroline Lochboehler. This recommendation was concurred in by the Chief of Engineers and the Secretary of War, and the papers in the case were on February 20, 1895, referred to the House Committee on Public Buildings and Grounds and ordered to be printed. They are to be found in House Ex. Doc. No. 327, Fifty-third Congress, third session.

The Secretary of War, April 1, 1895, granted a revocable license to John G. Rick to maintain and use his house in its present position, situated partly on the lands of the United States known as the Washington Aqueduct lands, in the District of Columbia, upon certain provisions and conditions stated in the license.

April 20, 1895, Mr. William Burroughs was notified to remove a shed, situated in part on the Aqueduct lands off said lands within one year from this date. May 3, 1895, Mr. Arthur B. Cropley was served with notice to remove two barns, likewise situated, off said lands, within one year from April 20, 1895.

Owners of fences in whole or in part on Aqueduct lands, as specified in detail in the reports of November 5, 1890, April 12, 1894, and February 15, 1895, will be notified of their fences being on these lands, and also that when these fences are rebuilt they must not be placed on or encroach on the lands of the United States, as soon as drawings can be prepared to accompany the notices to be served.

In accordance with notices given, buildings belonging to private parties have been removed by them from Aqueduct lands—one near the gatehouse at Great Falls and one near Chautauqua.

Report was made March 11, 1895, on a claim for damages for earth taken by the United States between boundary stones 33 and 34 on the Conduit road. The damage was trivial, and occasioned mainly more than twenty-five years ago and before the land from which it was taken passed to the parties claiming damages.

MEASUREMENT OF DAILY AND HOURLY CONSUMPTION AND WASTE OF WATER.

[Hourly and total flow from the distributing reservoir for the twenty-four hours ending at 8 a. m. June 26, 1894. City temperature in the shade at 2 p. m. June 25, 90°.]

Hour.	Outflow per hour.	Hour.	Outflow per hour.
June 25, from—	*Gallons.*	June 25, from—	*Gallons.*
8 a. m. to 2 p. m	2,372,006	10 p. m. to 11 p. m	1,643,932
9 a. m. to 10 a. m	2,090,182	11 p. m. to 12 midnight	1,505,442
10 a. m. to 11 a. m	2,504,680	June 26, from—	
11 a. m. to 12 noon	1,945,147	12 midnight to 1 a. m	1,640,659
12 noon to 1 p. m	2,220,431	1 a. m. to 2 a. m	1,638,964
1 p. m. to 2 p. m	1,940,058	2 a. m. to 3 a. m	1,500,790
2 p. m. to 3 p. m	1,937,877	3 a. m. to 4 a. m	1,771,762
3 p. m. to 4 p. m	1,935,452	4 a. m. to 5 a. m	1,633,654
4 p. m. to 5 p. m	2,209,038	5 a. m. to 6 a. m	2,174,489
5 p. m. to 6 p. m	2,343,648	6 a. m. to 7 a. m	2,172,389
6 p. m. to 7 p. m	2,202,736	7 a. m. to 8 a. m	2,169,287
7 p. m. to 8 p. m	1,924,798		
8 p. m. to 9 p. m	1,922,381	Total	47,182,681
9 p. m. to 10 p. m	1,782,879		

By the police census of this city June, 1892, a population of 228,002 was found; by that completed December 31, 1894, a population of 270,514. Assuming the increase of population to have been uniform, at the rate determined from these two enumerations, the population in June, 1895, was 279,000, and the consumption and waste per capita for this population on June 25, 1895, was 170 gallons. Under the same assumptions the consumption and waste per capita March 29, 1894, was 169 gallons; and June 28, 1894, 188 gallons.

Consumption and waste of water in the city as measured annually in the latter part of June of each year, from 1874 to 1895, both inclusive.

Year.	Gallons.	Year.	Gallons.	Year.	Gallons.
1874	17,554,848	1882	29,727,864	1890	35,541,845
1875	21,000,000	1883	24,314,715	1891	38,594,743
1876	24,177,797	1884	24,827,113	1892	41,161,780
1877	23,252,932	1885	25,219,194	1893	46,727,108
1878	24,885,945	1886	25,542,476	1894	49,162,357
1879	25,947,642	1887	26,878,424	1895	47,182,681
1880	25,740,138	1888	29,115,774		
1881	26,525,991	1889	27,708,779		

MISCELLANEOUS.

On the request and at the expense of the Columbia Railway Company the 30-inch main in Massachusetts avenue, near Seventh street NW., and in Mount Vernon Place and Square was lowered about 2 feet under regulations prescribed by the Secretary of War, under the provisions of an act of Congress approved August 6, 1894.

Changes in the location of the 12-inch main in M street near Thirty-sixth street and the method of crossing the 48-inch main and of protecting the 36-inch main in that vicinity, requested and submitted by the Washington and Georgetown Railroad Company, were approved by the Secretary of War subject to regulations prescribed under the provisions contained in sections 3 and 4 of an act of Congress approved August 23, 1894.

Iron brackets for carrying electric cable were erected on the abutments of the Aqueduct Bridge at Rock Creek by the United States Electric Lighting Company, under authority of a revocable license granted by the Secretary of War.

The watchmen of the three divisions of the Aqueduct have been furnished with revised detailed statements of their duties.

All unserviceable property pertaining to the Aqueduct was inspected and condemned; some of this condemned property was sold and the proceeds of the sale, $31, deposited in the United States Treasury.

Repairs were made to the gauge staff and door of the high-service reservoir, the watchman's house at Great Falls, the laborer's house at the Dalecarlia reservoir, to this office, and to the Aqueduct stable.

EXPLANATIONS OF ESTIMATES.

Especial attention is invited to several works that are urgently needed, which have all been mentioned in the last and previous annual reports of this office.

Storage yard.—In previous reports the necessity has been stated for a yard near the Aqueduct office for the storage of articles that are necessary for repairing any breaks that may occur in the 21 miles of trunk mains belonging to the United States. The storage yard on the bank of Rock Creek, in rear of and pertaining to the Aqueduct office, is entirely unsuited to the purpose. It is too low, and the route from it to the level of the street being steep and tortuous, before the very heavy castings required for these repairs could be hauled out much damage and destruction of property might be done.

Former remarks of Colonel Elliot on this subject are quoted and the estimate again submitted:

> I have provided supplies for use in case of breaks in the 48-inch and other mains, comprising sections of pipe, curves, crosses, reducers, sleeves, etc., a heavy wagon for hauling them where needed, lifting jacks, and efficient pumps; also machinery for lowering the pipes in the trenches, and the implements and material required for handling and calking.
>
> A portion of these supplies has been placed in a yard which I have arranged on the public land at the distributing reservoir, for use in the country portions of the routes of the mains, and the remainder, for use in the city portions of these routes, has been placed in a portion of Twenty-seventh street, near M Street Bridge, which has been loaned for the purpose by the District government until the street is wanted for improvement.
>
> As we shall not be able, probably, to retain this place, except for a short time, a permanent yard in the city should be purchased for use as a storage yard. It should be near this office, and at or near the grade of the street, so that the heavy castings and machinery required for repairs can be quickly gotten out.
>
> I believe that a suitable lot can be obtained by purchase or, if need be, by condemnation for $10,000, and I recommend an appropriation of this amount for the purpose.

In several previous annual reports attention has been invited to several other works that in my judgment are required for the improvement, preservation, and repair of the Aqueduct. The estimates therefor are again submitted and the explanations of their necessity restated.

Protection of the inlet to the conduit at Great Falls.—The bank of the Chesapeake and Ohio Canal, which runs parallel to the Potomac at Great Falls, and about 150 feet from it, is about 16½ feet higher than the uncovered chamber, just above the Maryland end of the Aqueduct dam that forms the inlet from the river to the conduit.

In the flood of November, 1877, which rose at Great Falls to the height of 160 feet above the datum of the Aqueduct, or 12 feet higher than the crest of the dam, the canal bank at a point opposite the inlet was washed down to the river and a part of it into the inlet. I quote from the annual report of the Aqueduct for 1878:

"The masonry forming the arch of the feeder was uncovered from a point near the middle of the canal to the mouth of the feeder, a distance of 150 feet. The chamber at the head of the Aqueduct was filled with stones that had formed the slope wall of the canal, and the Aqueduct feeder for a distance of 300 feet was filled with débris to depths varying from 3 to 6 feet, so as to entirely stop the flow of water during the ordinary low stages of the river."

In the still higher flood of June, 1889, *which rose to the height of 16 feet over the Aqueduct dam*, the canal bank was again washed down to the river, but fortunately the damage did not occur immediately opposite the inlet to the conduit, but from 200 to 400 feet higher up, so that the major part of the débris being left on the margin of the river and a part of it being carried over the dam, not so much filling of the inlet to the conduit was done, but, as in the flood of 1877, it was partially obstructed.

The annual report of the Aqueduct for 1889 says:

"The banks of the Chesapeake and Ohio Canal above and below the mouth of the conduit were carried away and that opposite the conduit was threatened. A number of men were kept at work on this bank during the freshet, and it is believed that had it not been for the energetic work of this force and the widening and strengthening of the bank at this locality in April, great damages would have occurred at the mouth of the conduit."

It will be observed that in the freshet of 1877 not only the inlet chamber, but the conduit itself was filled with débris to a depth of from 3 to 6 feet *for a distance of 300 feet in from its mouth*, but, the water in the river being at a high stage, there was still waterway enough in the conduit above the débris to enable the supply to the city to be kept up. Had a complete closure of the mouth of the conduit occurred, with 12 to 16 feet of water over it, there would have been no possible way, with the torrent raging over the mouth, to remove the obstruction before the river subsided, and the water supply to the city would have been cut off.

There is no more important part of our system of water supply to be carefully guarded than the head of the conduit at Great Falls, and in order to avert dangers like those of 1877 and 1889, to which the water supply is liable in every freshet, a masonry wall should be built between the river and the canal, rising a few feet higher than the latter and extending up river from the mouth of the conduit as far as the limit of the Government land, and thence, at about a right angle, and still on the Government land, to the shore of the river. The estimated cost of this wall is $5,000.

Inserting air valves and blow-off valves in the 30-inch and 36-inch mains.—"It is important that more efficient facilities be provided for emptying and filling the old mains in case of accident, and of making connection from main to main.

"In either case a section of the main must be cut out and a new piece inserted; but before this can be done the main valve, at whatever distance on either side, must be shut, and the section of the main between these two valves, generally more than a mile long, must be emptied of its water. The time required for emptying depends not only on the sizes of the blow-offs in the valleys crossed by the mains, but also on the sizes of the air valves provided at the summits; for the water can not, of course, in any case be gotten out of a main any faster than the air required to take its place can be gotten in.

"In making the connections at New Jersey avenue and L street between the 36-inch main and the 24-inch by-pass, on the night of the 14th of April, 1890, more than five hours were consumed in freeing the main of water, owing to insufficient blow-offs and air valves in the 36-inch main, and the refilling of the main after the connection had been made was so much prolonged by the want of proper valves for the egress of the air that it was nearly noon of the next day before the charging of the main was completed.

"Similar delays occurred at each of the numerous connections between the mains that were made after the 48-inch main was completed, and I was in each case obliged, in getting the air into the mains for emptying and out of them for filling them again with water, to have recourse not only to fire hydrants, but to the service-pipe spigots in private houses in the vicinities of these connections."

These delays are very expensive, night work costing about double the rates of day work, and the danger in case of fire in the district cut off from its supply of water is so great that large air valves and blow-off valves should be placed on both the 30 and 36-inch mains as soon as an appropriation can be obtained for the purpose. A patented device very much reduces the time required for inserting these valves, as well as their cost, and, what is very important, it enables the work to be done while the mains are under their ordinary pressure. The cost of inserting the required blow-off and air valves in the 36 and 30-inch mains will be about $6,250.

For two years the sum of $21,000 has been asked for in the annual estimates of this office for the maintenance and repair of the Aqueduct and the reservoirs, mains, roads, etc., connected therewith.

Other works administered by the force connected with this office have borne part of the expense of that force during the past fiscal year and will during the coming year. But these works will be completed during the next year or soon after its close. It will be wise, then, to increase by $1,000 the appropriation for maintenance and repair of the

Aqueduct during the fiscal year ending June 30, 1897. In support of this statement attention is invited to the following extract from the annual report of my predecessor, Col. George H. Elliot, Corps of Engineers, U. S. A., retired, whose close study of all matters connected with the existing water supply of this city has made him an authority on this subject.

DESIRED INCREASE IN THE ANNUAL APPROPRIATION FOR MAINTENANCE AND REPAIR OF THE AQUEDUCT AND THE RESERVOIRS, MAINS, ROADS, ETC., CONNECTED THEREWITH.

I renew the following statement made in my former reports respecting the importance of increasing the appropriation for maintenance and repair of the Aqueduct:

While works that have cost $565,000 have been added to the Aqueduct system by the laying of more than 8 miles of 48-inch and other large water mains under the act of March 2, 1889, with their numerous valve chambers, main valves, air valves, blow-off valves, and other adjuncts, all of which have to be carefully watched and kept in repair, there has been no increase in the appropriation for maintenance and repair of the Aqueduct.

It has been for many years and is now $20,000, and it proves entirely inadequate for keeping in repair the long line of works, including the dam at Great Falls, the conduit, the Conduit road (which is paved for the protection of the conduit), the reservoirs, the gatehouses, the fences of the Aqueduct and Conduit road lands, the dwellings of the watchmen of the different divisions, and the more than 20 miles of trunk mains in the city supplying the distributing system of the District of Columbia, besides paying the salaries of the watchmen and other employees.

Twenty-one thousand dollars was asked for in my last annual estimates, and it is again asked for. It is not a large sum to provide for the annual maintenance and repair of works that have cost more than $4,000,000, and I could expend much more in works of preservation and repair that would be for the best interests of the Government.

Money statement.

WASHINGTON AQUEDUCT.

July 1, 1894, balance unexpended		$0.41
Amounts appropriated by act approved—		
August 7, 1894, for maintenance and repairs	$20,000.00	
August 7, 1894, for repair of bridges	5,000.00	
August 7, 1894, for protecting conduit	5,000.00	
March 2, 1895, for removing deposits	14,000.00	
		44,000.00
		44,000.41
January 10, 1895, amount deposited in Treasury, being balance of appropriation of 1894		.41
June 30, 1895, amount expended during fiscal year		21,008.51
July 1, 1895, balance unexpended		22,991.49
July 1, 1895, outstanding liabilities		3,307.25
July 1, 1895, balance available		19,684.24
Amount that can be profitably expended in fiscal year ending June 30, 1897		21,000.00

ESTIMATES.

The estimates of appropriations that should be made for the year ending June 30, 1897, are as follows:

For protecting the inlet to the Aqueduct at Great Falls	$5,000
For purchase or condemnation of a site for a storage yard	10,000
For inserting air valves and blow-off valves in the 36-inch and 30-inch mains	6,250
For maintenance and repair of the Aqueduct, and the reservoirs, mains, roads, etc., connected therewith	21,000
Total	42.250

Appropriations made for the Washington Aqueduct, with the dates of acts for the same.

Date.	Amount.	Date.	Amount.	Date.	Amount.
September 30, 1850...	$500	March 3, 1871.....	$114, 196	February 25, 1885...	$20, 000
August 31, 1852 *a*....	5, 000	June 10, 1872.....	70, 555	July 9, 1886.....	20, 000
March 3, 1853.....	100, 000	January 23, 1873....	14, 000	March 3, 1887.....	20, 000
March 3, 1855	250, 000	March 3, 1873 *c*.....	43, 600	July 18, 1888 *h*.....	20, 000
August 18, 1856.....	250. 000	June 23, 1874 *d*.....	36, 400	March 2, 1889 *i*.....	20, 000
March 3, 1857.....	1, 000, 000	March 3, 1875.....	26, 000	August 6, 1890 *j*.....	25, 500
June 12, 1858	800, 000	July 31, 1876.....	22, 000	March 3, 1891 *k*.....	20, 000
June 25, 1860	500, 000	March 3, 1877.....	15, 000	July 14, 1892.....	20, 000
July 4, 1864.....	150, 000	June 20, 1878	15, 000	March 3, 1893.....	80, 000
July 28, 1866.....	142, 584	March 3, 1879 *e*.....	20, 000	August 7, 1894 *m*....	82, 500
December 20, 1866....	12, 000	June 4, 1880 *f*.....	20, 000	March 2, 1895.....	71, 500
March 2, 1867	20, 000	March 3, 1881.....	20, 000		
July 25, 1868.....	52, 500	July 1, 1882 *g*	20, 000	Total.....	4, 304, 657
March 3, 1869.....	25, 000	March 3, 1883.....	20, 000		
July 15, 1870 *b*	120, 822	July 5, 1884.....	20, 000		

NOTE.—Reverted to the Treasury: (*a*) $2.81, (*b*) $46.25, (*c*) $560.87, (*d*) 35 cents, (*e*) $1,109.87, (*f*) $381.06 (*g*) $1,354.17, (*h*) $2,266.34, (*i*) $4.12, (*j*) $5,500, (*k*) $2.49, (*m*) 41 cents; total, $11,228.74. Since 1878 one-half of the amounts appropriated have been contributed by the United States and the other half by the District of Columbia.

B B B 2.

INCREASING THE WATER SUPPLY OF WASHINGTON, DISTRICT OF COLUMBIA.

This work was commenced under an appropriation made by an act of Congress approved July 15, 1882.

The plan consisted in raising the dam in the Maryland Channel at the Great Falls of the Potomac to an elevation of 148 feet above mean tide at the Washington Navy-Yard and its extension at that height across Conns Island and the Virginia Channel of the river; extending the Washington Aqueduct from the distributing reservoir above Georgetown to the site selected for the new reservoir near Howard University by a tunnel 20,696.3 feet long; constructing at the tunnel outlet a new reservoir of about 300,000,000 gallons capacity, and connecting this reservoir by a new line of large mains with the existing system of water mains in the city of Washington.

So much of the plan as related to raising and extending the dam at Great Falls was completed during the fiscal year 1887. No operations under the project were carried on during the past fiscal year.

A watchman has been employed during the year at the new reservoir. His duties have included guarding the stone at the mouths of all shafts, except the one at Foundry Branch, which is under the care of the watchman at the distributing reservoir.

The following is a list of the appropriations for this work, with the date of act for the same:

July 15, 1882	$1, 485, 279. 30
July 7, 1884	87, 500. 00
March 3, 1885	87, 500. 00
March 26, 1886	5, 000. 00
August 4, 1886	555, 000. 00
March 30, 1886	355, 000. 00
Total	2, 575, 279. 30

Money statement.

Title of appropriation.	July 1, 1894, balance unexpended.	June 30, 1895, amount expended and liabilities incurred during fiscal year.	July 1, balance unexpended and available.
Land to extend Aqueduct	$24,454.84	.....	$24,454.84
Extension of Aqueduct	271,935.82	* $15,718.21	256,217.61
Main connections	1,989.18	.....	1,989.18
Land for reservoir	173.09	.....	173.09
Constructing reservoir and gatehouse	79,538.76	480.75	79,058.01
Water rights and land to extend dam at Great Falls	44,882.04	.....	44,882.04
Completion and extension of dam at Great Falls	4,665.52	* 4,665.52	.....
Aggregate	427,639.25	20,864.48	406,774.77

* For details of these expenditures and liabilities see money statements for raising the height of the dam at Great Falls and testing the tunnel conduit.

No estimate for further appropriation is submitted.

The act of Congress approved March 2, 1895, making appropriations for the expenses of the government of the District of Columbia for the fiscal year ending June 30, 1896, and for other purposes, contained the following:

For raising the height of the dam at Great Falls, together with the cost of such other work as may be found necessary in connection therewith, including the cost of strengthening the conduit, and for damages on account of flooding of land, and other damages, $125,000, for which amount and purposes the available balance of the appropriation for increasing the water supply of the city of Washington shall be applicable, subject to all the provisions and restrictions of the act to increase the water supply of the city of Washington, and for other purposes, approved July 15, 1882, and of the act approved July 5, 1884, making appropriations for the expenses of the government of the District of Columbia as to apportionment and settlement between the United States and the District of Columbia, and the refunding thereof. And in the execution of this work, Gen. Thomas L. Casey shall be associated with the proper officer in charge of the Washington Aqueduct as consulting engineer.

For testing the tunnel conduit to determine the amount of its leakage, $25,000, to be taken from the appropriation "for increasing the water supply of Washington, D. C.," to be immediately available.

There shall be prepared, upon careful investigation by the proper officer of the Government having the charge of the Washington Aqueduct and the water supply of the city of Washington, a full and detailed report, which shall be submitted to Congress on the first Monday in December, 1895, upon the feasibility and propriety of completing the tunnel conduit as now projected; the completion of the new reservoir, including its dam or any modifications to the same deemed necessary; and upon the results as to the supply of water to the city when said dam, the raising of the dam at the Great Falls, the conduit, and reservoir are completed. And if such officer and consulting engineer shall conclude that it is impracticable or too expensive to repair such tunnel conduit, then they shall report some plan for bringing increased water supply from the reservoir in Georgetown to Washington by pipes or otherwise.

Each separate item of the report shall be accompanied by a detailed estimate of the cost of the work required; and the necessary costs, not to exceed $10,000, connected with the inquiry and reports shall be defrayed from the appropriation for "increasing the water supply of Washington, D. C.:" *Provided*, That in the preparation of this report Gen. Thomas L. Casey, United States Army, shall be associated with the proper officer of the Government in charge of the Aqueduct as consulting engineer, and his signature shall be appended to said report in said capacity, and said report shall also be accompanied with the judgment of the Chief of Engineers, and made to the Secretary of War, who shall transmit the same to Congress, with his views thereon.

The report to be submitted to Congress December 2, 1895, is under study.

Amount made available by act approved March 2, 1895, $10,000, none of which has as yet been expended.

For raising the height of the dam at Great Falls.—During the summer and fall of 1892 the Potomac at Great Falls was at a lower stage than

has ever before been known within the memory of the oldest inhabitant. On seventy-two days the gauge above the dam showed a depth of water on the dam of only about 7 inches, and on five days it showed but 6 inches. The height of the crest of the dam is 148 feet above datum; hence that of the lowest water was 148 feet 6 inches. The height of the crown of the conduit is 151 feet above datum; hence at its lowest known stage the river surface was 2 feet 6 inches below the crown of the conduit.

It is proposed to raise the height of the dam 2 feet 6 inches, so that at its lowest stage the river will fill the mouth of the conduit.

The approved project contemplates removing the present coping stones, increasing the height of the body of the dam the desired amount, and replacing the coping stones, bolting them down by 2-inch bolts 7 feet long.

Stone is to be obtained from the Government quarries at Seneca and all work is to be done by day labor.

The dam at present is slightly out of level and it is proposed to correct this while raising the dam, so that its top shall be at a uniform height of 150 feet 6 inches above datum.

The Government quarry at Seneca, Md., was reopened March 21, 1895, since which date work has been limited to quarrying and cutting stone, to preparing plans for placing this in the dam during the seasons of low water in this and the next calendar years, and to making a survey to determine the extent of damage, if any, to the Chesapeake and Ohio Canal and to other property which may be occasioned by raising the dam.

Money statement.

Amount made available by act of March 2, 1895	$125,000.00
June 30, 1895, amount expended during fiscal year	4,006.20
July 1, 1895, balance unexpended	120,993.80
July 1, 1895, outstanding liabilities	3,155.68
July 1, 1895, balance available	117,838.12

Testing the tunnel conduit.—The object of this test, as stated in the act of March 2, 1895, is to determine the amount of leakage occurring when the tunnel has been filled with water.

Work on this tunnel was suspended November 1, 1888, and as soon as the contractors removed their plant the tunnel was allowed to fill with water until it flowed out at Rock Creek shaft. At suspension of work 6,079.3 feet of the tunnel and three of the five shafts were not lined.

The approved project for testing the tunnel covers removing rock and earth from the bottom of four of the shafts, pumping out the tunnel, closing the three intermediate shafts with brick and concrete masonry, extending the east shaft by an iron standpipe, and filling the tunnel and shafts with water so as to subject them as nearly as possible to the pressure to which they would be subjected when completed.

Débris has been removed from the three intermediate shafts, and these three shafts and the tunnel headings starting from them have been pumped out. Detailed measurements have been taken to determine any changes that may be occasioned in the tunnel by subjecting it to pressure. These will be of service in preparing estimates for further work on the tunnel should such be authorized.

The masonry work of closing Rock Creek shaft has been completed. This consists of a lower two-ring arch of vitrified bricks; 6 feet above

this a six-ring inverted arch and concrete between the two arches. A 12-inch iron air shaft is carried to the top and is closed by a 12-inch gate valve and a 3-inch angle valve.

The lower arches are completed at the two other shafts, and part of the concrete in place. At Foundry Branch shaft it has been found advisable to place the two arches about 30 inches apart and then add concrete above the second arch. At Champlain avenue the shaft is entirely too wet for the construction of the second arch thoroughly at any reasonable expense; this arch will therefore be omitted and additional concrete used. Air shafts will be inserted as at Rock Creek shaft.

Of the hoisting engines and boilers required for this work, one boiler and one portable boiler and engine have been loaned by the authorities of the District of Columbia; two boilers are the property of the United States, one having been purchased for this work, and two hoisting engines and boilers have been rented.

Six vertical mining pumps and about all necessary steam and water pipe were ordered April 11 of the A. S. Cameron Steam Pump Works, New York, whose bid therefor, submitted in answer to circular letter, was most advantageous to the United States, considering the proposed time of delivery. All pipe and four pumps were delivered April 17, and the remaining pumps April 20. Two pumps were at work at Rock Creek shaft April 20 and a third April 22. Pumping has been continued night and day. These pumps have 12-inch steam cylinders, 7-inch plungers, and 13-inch stroke.

The Engineer Commissioner of the District of Columbia has, at the request of this office, kindly caused tests to be made from time to time of the quality of the water removed from the tunnel. The rate of seepage into the tunnel was measured on May 1 at Rock Creek shaft by stopping all pumps for sixty-two minutes, noting the increase of height of water, and then pumping until the increase had disappeared, and at the same time noting the number of strokes of the pump. The result is, of course, only approximate.

As soon as the débris is removed from the bottom of the Howard University shaft, and access thus gained to the heading there, measurements of masonry and tunnel work will be made, and then the filling of the tunnel can be commenced, and if leakage be not excessive can be carried to reference 100 without waiting for the erection of the standpipe at that shaft, and to reference 145 feet above mean high tide when that pipe is in place.

Money statement.

Amount made available by act of March 2, 1895	$25,000.00
June 30, 1895, amount expended during fiscal year	8,409.06
July 1, 1895, balance unexpended	16,590.94
July 1, 1895, outstanding liabilities	4,812.79
July 1, 1895, balance available	11,778.15

B B B 3.

ERECTION OF FISHWAYS AT GREAT FALLS.

Under a ruling concerning the act of July 15, 1882, providing for the construction of these fishways, the Secretary of War decided that the engineer officer in charge should be held responsible only for the proper

protection of the Aqueduct dam at Great Falls and the disbursement of the funds appropriated, the Commissioner of Fish and Fisheries being responsible under the act for the plans and specifications of the fishways and their execution.

No work has been done on the fishways during the last fiscal year for want of funds. Sections 2, 3, 4, 5, and 6, and a portion of the permanent dam have been completed. There remains to be constructed the remainder of this dam and section 1.

Property pertaining to this work was removed from a temporary storehouse at Great Falls to the brick storehouse at the distributing reservoir.

The following extract is from the annual report of this office for the fiscal year ending June 30, 1894:

The Commissioner of Fish and Fisheries is of the opinion that an additional sum of $7,890 will be required to complete the work, and requests that the estimate for it contained in my last annual report be submitted. It was not acted on by Congress. His letter to me is as follows:

"I have to request that you include in your estimates for the ensuing fiscal year an item of $7,890 for the completion of the Great Falls fishways. The additional appropriation asked for is made necessary, first, by reason of an increased cost of sections 2 and 3 over and above the estimate; second, by reason of the construction of a permanent deflecting dam which was found essential for the better protection of the fishways and to obtain control of the water supply to the same; third, for the reason that a sufficiently large amount is included to cover the work of cleaning out the river bed between the fishways, and to construct a tool shed with small office; and, lastly, to provide a small fund with which to repair any damage to the fishways from the effects of the spring freshets before the completion of the permanent deflecting dam."

The appropriations for this work to date are as follows:

Act of July 15, 1882	$50,000
Act of February 1, 1888	25,000
Act of August 5, 1892	15,000

Money statement.

July 1, 1894, balance unexpended	$32.02
June 30, 1895, amount expended during fiscal year	23.03
July 1, 1895, balance unexpended	8.99
July 1, 1895, outstanding liabilities	2.93
July 1, 1895, balance available	6.06
Amount deemed necessary by the Commissioner of Fish and Fisheries for the completion of the work	7,890.00

APPENDIX 1.

CONDITION OF THE WATER DURING THE YEAR.

Condition of water at Great Falls, Dalecarlia receiving reservoir, and distributing reservoir, and height of water over dam at Great Falls for each day in the year.

[The height of water on the dam at Great Falls varied during the year from a minimum of .6 of a foot (which was the height for eleven days in the latter part of July, all of August, and eighteen days in September) to a maximum of 3.4 feet on March 3.]

Day of month.	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).
	Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.	
	July, 1894.				August, 1894.				September, 1894.				October, 1894.			
1	36	36	36	.80	36	36	36	.60	36	36	36	.60	35	36	22	.60
2	36	36	36	.70	36	36	36	.60	36	36	36	.60	36	36	27	.60
3	36	36	36	.70	36	36	36	.60	36	36	36	.60	25	36	31	1.00
4	36	36	36	.70	36	36	36	.60	36	36	36	.60	13	36	36	1.00
5	36	36	36	.70	36	36	36	.60	36	36	36	.60	7	36	36	.90
6	36	36	36	.70	36	36	36	.60	36	36	36	.60	7	36	36	.80
7	36	36	36	.70	36	36	36	.60	36	36	36	.60	4	36	36	.80
8	36	36	36	.70	36	36	36	.60	36	36	36	.60	8	36	22	.80
9	36	36	36	.70	36	36	36	.60	36	36	36	.60	20	36	25	.70
10	36	36	36	.70	36	36	36	.60	36	36	36	.60	5	36	25	.90
11	36	36	36	.70	36	36	36	.60	36	36	36	.60	4	10	25	1.20
12	36	36	36	.70	36	36	36	.60	36	36	36	.60	2	6	7	1.10
13	36	36	36	.70	36	36	36	.60	36	36	36	.60	4	8	2	1.10
14	36	36	36	.70	36	36	36	.60	36	36	36	.60	5	8	2	1.00
15	36	36	36	.60	36	36	36	.60	36	36	36	.60	7	10	3	1.00
16	36	36	36	.60	36	36	36	.60	36	36	36	.60	9	12	4	1.00
17	36	36	36	.60	36	36	36	.60	36	36	36	.60	8	15	7	.80
18	36	36	36	.60	36	36	36	.60	31	36	36	.60	8	22	9	.80
19	36	36	36	.60	36	36	36	.60	33	36	36	.70	12	23	13	.80
20	36	36	36	.60	36	36	36	.60	4	36	36	1.40	21	25	16	.80
21	36	36	36	.60	36	36	36	.60	1	36	36	1.40	27	25	20	.70
22	36	36	36	.60	36	36	36	.60	3	36	8	1.20	28	33	20	.70
23	36	36	36	.60	36	36	36	.60	4	36	6	1.20	30	36	30	.70
24	36	36	36	.60	36	36	36	.60	6	36	5	1.00	33	36	36	.70
25	36	36	36	.60	36	36	36	.60	6	36	6	.90	27	36	36	.70
26	36	36	36	.70	36	36	36	.60	7	36	7	.90	33	36	36	.70
27	36	36	36	.70	36	36	36	.60	8	36	9	.80	36	36	36	.70
28	36	36	36	.70	36	36	36	.60	14	36	10	.80	25	36	36	.70
29	36	36	36	.70	36	36	36	.60	17	36	11	.70	24	36	36	.70
30	36	36	36	.70	36	36	36	.60	26	36	14	.70	36	36	36	.70
31	36	36	36	.70	36	36	36	.60	-----	------	------	------	36	36	36	.70
	November, 1894.				December, 1894.				January, 1895.				February, 1895.			
1	33	36	36	.70	36	36	36	.70	36	36	36	.70	12	36	13	1.00
2	14	36	36	.90	36	36	36	.70	36	36	36	.70	20	36	15	1.00
3	4	36	36	1.00	36	36	36	.70	36	36	36	.70	30	36	24	.70
4	2	8	21	1.20	36	36	36	.70	36	36	36	.70	36	36	30	.60
5	2	9	9	1.20	36	36	36	.70	36	36	36	.70	36	36	36	.60
6	3	4	5	1.10	36	36	36	.70	36	36	36	.70	36	36	36	.60
7	6	4	4	1.10	36	36	36	.70	36	36	36	.70	36	36	36	.60
8	8	10	3	1.10	36	36	36	.70	16	36	36	.90	36	36	36	.60
9	7	16	4	1.00	36	36	36	.70	4	36	36	1.20	36	36	36	.60
10	15	36	8	.90	36	36	36	.70	2	36	11	1.90	36	36	36	.60
11	20	36	10	.90	36	36	36	.80	2	36	6	2.90	36	36	36	.60
12	25	36	15	.90	5	36	36	1.00	2	36	3	2.80	36	36	36	.70
13	30	36	22	.90	2	36	36	1.10	2	36	2	2.90	36	36	36	1.00
14	33	36	30	.80	4	15	9	1.20	2	36	2	1.00	36	36	36	1.00
15	36	36	32	.80	5	10	6	1.20	6	36	4	1.40	36	36	36	1.00
16	36	36	36	.80	6	13	6	1.20	8	36	5	1.50	36	36	36	1.10
17	36	36	36	.80	7	18	6	1.20	6	25	5	1.60	36	36	36	1.10
18	36	36	36	.80	10	19	6	1.10	12	18	6	1.50	36	36	36	1.00
19	36	36	36	.80	12	28	6	1.10	16	25	7	1.50	36	36	36	1.00
20	36	36	36	.80	23	31	7	1.00	19	28	8	1.50	36	36	36	1.00
21	36	36	36	.80	30	36	14	1.00	19	17	8	1.50	36	36	36	1.00
22	36	36	36	.80	36	36	21	1.00	15	19	11	1.90	36	36	36	1.00
23	36	36	36	.70	36	36	26	.90	13	28	14	1.80	36	36	36	1.00
24	36	36	36	.70	36	36	32	.90	15	36	20	1.90	11	36	36	1.00
25	36	36	36	.70	36	36	36	.90	10	36	21	1.90	14	36	36	1.00
26	36	36	36	.70	36	36	36	.90	8	36	13	1.70	6	36	36	1.00
27	36	36	36	.70	36	36	36	1.00	5	36	9	1.50	4	36	36	1.00
28	36	36	36	.70	36	36	36	1.00	8	30	9	1.40	4	36	17	1.10
29	36	36	36	.70	36	36	36	.90	10	25	7	1.20	-----	------	------	------
30	30	36	36	.70	36	36	36	.80	10	36	9	1.20	-----	------	------	------
31	-----	------	------	------	36	36	36	.70	12	36	12	1.10	-----	------	------	------

Condition of water at Great Falls, Dalecarlia receiving reservoir, and distributing reservoir, etc.—Continued.

Day of month.	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).	Condition of water.			Height of water over dam at Great Falls (feet).
	Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.		Great Falls.	Receiving reservoir, south connection.	Distributing reservoir, effluent gatehouse.	
	March, 1895.				April, 1895.				May, 1895.				June, 1895.			
1	2	16	11	1.90	19	20	36	1.50	3	8	2	1.40	36	14	36	1.00
2	2	15	7	2.80	11	36	36	1.40	2	11	5	2.10	36	23	36	1.00
3	2	12	5	3.40	18	36	36	1.40	4	12	3	2.00	36	23	36	.90
4	1	18	3	3.20	13	36	36	1.40	6	15	13	2.00	36	36	36	.90
5	1	20	2	2.60	8	36	36	1.50	11	20	20	1.80	36	36	36	.80
6	3	18	2	2.20	12	36	36	1.40	13	26	20	1.70	4	36	36	.90
7	5	23	3	1.90	16	36	30	1.30	18	36	30	1.50	25	36	36	.90
8	9	25	4	1.80	14	36	27	1.30	18	36	36	1.30	36	36	36	.90
9	9	30	6	1.80	3	8	36	1.60	24	36	36	1.30	36	36	36	.80
10	7	27	7	1.70	2	5	12	2.70	2	36	36	1.40	25	36	36	.80
11	5	14	7	1.70	1	6	3	2.80	3	36	12	1.30	23	36	36	.70
12	6	12	6	1.70	2	6	3	2.20	2	6	24	1.30	24	36	36	.70
13	9	10	7	1.70	4	7	3	1.90	2	7	11	1.10	7	36	36	.80
14	4	15	9	1.70	6	8	3	1.70	7	16	7	1.20	12	34	36	.80
15	5	26	8	1.70	10	12	4	1.70	6	17	15	1.30	25	27	36	.80
16	3	12	9	2.10	12	18	7	1.60	11	20	13	1.30	6	36	36	.80
17	3	10	5	2.50	14	20	8	1.50	19	14	15	1.10	10	36	36	.80
18	3	12	8	(*)	20	23	16	1.40	26	21	16	1.10	25	36	36	.80
19	5	19	6	2.10	30	36	22	1.30	27	28	30	1.10	36	36	36	.80
20	8	13	6	1.90	31	36	32	1.30	27	36	36	1.10	36	36	36	.80
21	10	19	7	1.80	32	36	36	1.30	31	36	36	1.10	36	36	36	.70
22	10	22	8	1.80	36	36	36	1.20	9	36	36	1.20	36	36	36	.70
23	14	28	8	1.60	36	36	36	1.20	9	36	36	1.20	36	36	36	.70
24	17	32	12	1.50	36	36	36	1.10	8	36	36	1.40	36	36	36	.70
25	22	29	13	1.50	36	36	36	1.00	9	36	36	1.40	36	36	36	.70
26	17	30	19	1.50	36	36	36	1.00	15	36	30	1.30	36	36	36	.70
27	10	29	24	1.50	36	36	36	1.00	8	36	36	1.20	1	36	36	.70
28	21	36	27	1.40	1	36	36	1.30	8	36	25	1.20	3	3	3	1.00
29	12	22	36	1.40	1	8	5	1.10	17	36	27	1.20	1	3	2	1.10
30	19	24	36	1.40	3	6	3	1.20	27	36	30	1.10	1	1	2	1.00
31	19	24	36	1.50	.....	.....	.....	.....	35	36	36	(*)	.....	.....	.....	.....

* All gates closed.

Number of days during the fiscal year 1894–95 on which the water was clear or turbid at the places indicated.

Places.	Clear.	Slightly turbid.	Turbid.	Very turbid.
Great Falls	205	26	52	82
Dalecarlia receiving reservoir	300	25	27	13
Distributing reservoir	249	17	38	61

NOTE.—In determining the condition of the water a metallic tube with glass ends is used. This is filled with water and the distance at which a ball immersed in the water can be seen from one of the ends is noted. When it can be seen at a distance of from 22 to 36 inches, inclusive, it is considered clear; from 15 to 21 inches, slightly turbid; from 8 to 14 inches, turbid, and from 0 to 7 inches, very turbid.

APPENDIX 2.

Daily gauge pressures at the office of the Washington Aqueduct at 9 o'clock a. m.

Month.	Main.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.	21.	22.	23.	24.	25.	26.	27.	28.	29.	30.	31.	Average.
1894.	*Inch*																																
July	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	48	35	35	36	36	35	36	35	36	37	36	36	35	36	36	36	35	35	35	35	35	35	36	35	36	36	36	35	35	36	35	36	35.54
August	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	48	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	37	36	37	36	36	36	37	36	36	36	37	37	37	37	37	36.26
September	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31
	48	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	....	37
October	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	48	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	37	35	35	36.80
November	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31
	36	31	31	31	31	31	31	31	21	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31
	48	35	35	35	35	35	35	35	35	35	35	35	36	35	35	35	35	35	36	35	35	35	35	35	35	35	35	35	36	36	35	....	35.13
December	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31	31	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31	31	31
	48	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	36	36	36	36	36	36	36	35	35.23
1895.																																	
January	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	48	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35
February	30	31	31	31	31	31	31	31	31	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	....	....	30.93
	36	31	31	31	31	31	31	31	31	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	....	....	30.93
	48	35	35	35	35	35	35	55	35	34	34	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	35	....	....	....	34.93
March	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31
	48	35	35	35	35	35	35	35	35	35	35	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	37	37	36	36	36	35	35.71
April	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	31
	48	36	36	36	36	35	35	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	36	35	35	35	35	....	35.77
May	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	30	30	30	30	31	31	31	31	31	31	31	30.84
	36	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	30	30	30	30	31	31	31	31	31	31	31	30.84
	48	36	37	36	36	36	36	36	35	35	35	35	35	36	35	35	35	34	35	35	34	34	34	34	34	34	34	34	34	34	34	32½	34.82
June	30	30	30	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	30.87
	36	30	30	30	30	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	31	....	30.87
	48	31½	33	33	33	34	34	34	34	35	34	35	35	35	34½	34½	35	34	35	35	35	35	34	35	34	34	34	34	34	34	35	....	34.22

APPENDIX 3.

OFFICE OF THE WASHINGTON AQUEDUCT,
Washington, D. C., December 31, 1894.

GENERAL: In a letter to the Secretary of War the Commissioners of the District of Columbia on the 21st of September last requested to be furnished with a list of the water mains which come within the purview of section 1803, Revised Statutes, forbidding the tapping of any mains laid by the United States in the District of Columbia, excepting by permission of the Chief of Engineers. This letter was referred to me on the 24th September for report (E. D., inclosure 2 of 7307), and in compliance with this direction I have to state the following list of the mains laid by the United States in the District of Columbia:

Routes of mains.	Size of mains.
	Inches.
In Four-and-a-half street west from College street to the new reservoir, near Howard University	75
In the Conduit road from the distributing reservoir to Foxall road; in Foxall road to Canal road; in Canal road to M street north; in M street north to New Hampshire avenue; in New Hampshire avenue to R street north, and in R street north to Fourth street west	48
In New Jersey avenue from L street north to Fourth street west; in Fourth street west to Florida avenue; in Florida avenue to Linden street; in Linden street to Four-and-a-half street west, and in Four-and a-half street west to College street	48
In the Conduit road from the distributing reservoir to Foxall road; from Foxall road to the Canal road at College Pond; in the Canal road to M street north; in M street north to Pennsylvania avenue; in Pennsylvania avenue to L street north, and in L street north to New Jersey avenue*	36
In New Jersey avenue from L street north to B street north; through the Capitol Grounds to East Capitol street, and in East Capitol street to Eleventh street east	30
In the Conduit road from the distributing reservoir to Foxall road; from Foxall road to the Canal road at College Pond; in the Canal road to M street north; in M street north to Pennsylvania avenue; in Pennsylvania avenue to Washington circle; through this circle to K street north; in K street north to Massachusetts avenue; in Massachusetts avenue to Mount Vernon Square; through this square and in Massachusetts avenue to New Jersey avenue, and in New Jersey avenue north to L street north and south to B street north	30
In Eighteenth street west from K street north to L street north	24
In Eleventh street west from U street north to K street north	24
In New Jersey avenue from L street north to K street north, and in K street north to Eleventh street east	24
In B street south from Tenth street west to Sixth street west; in Sixth street west to Maine avenue; in Maine avenue to the Botanical Garden; through this garden to the Capitol Grounds; through these grounds to the intersection of New Jersey avenue with B street north, and in B street north to Eleventh street east	20
In Seventh street west from G street north to F street north; in F street north to Eighth street west, and in Eighth street west to Pennsylvania avenue	12
In Four-and-a-half street west from Pennsylvania avenue to D street north, and from Maine avenue to the Arsenal	12
In Twenty-fourth street west from Pennsylvania avenue to the old Naval Observatory	12
In Florida avenue from Linden street to Fifth street west	12
In the Conduit road from the distributing reservoir to Foxall road; from the Foxall road to the Canal road at College Pond; in the Canal road to M street north; in M street north to Pennsylvania avenue; in Pennsylvania avenue to Fifteenth street west; in Fifteenth street west to Pennsylvania avenue; in Pennsylvania avenue to First street west; in First street east from B street north to Pennsylvania avenue; in Pennsylvania avenue to Eighth street east, and in Eighth street east to the navy-yard	12
In Pennsylvania avenue at Rock Creek Bridge to Twenty-ninth street west; in Twenty-ninth street west to P street north; in P street north to Thirty-second street west, and in Thirty-second street west to the high-service reservoir in Georgetown†	10
In Seventh street west from Massachusetts avenue to G street north	10

* This main was laid by the United States, but its cost was borne entirely by the cities of Washington and Georgetown.

† For the safety of the 48-inch main in M street, Georgetown, the portion of this main which is below a valve inserted in it just above M street in 1891, is not to be used and the valve is to be kept closed.

The foregoing list is as accurate as can be made from the plats in this office, which, in respect of the mains laid from the completion of the Washington Aqueduct in 1863 to the laying of the 36-inch main in 1871–72, are probably not entirely conclusive. The list does not include the water pipe supposed to have been laid by the United States to supply the Capitol from a spring that is now in the bed of the new reservoir near Howard University, or any other water pipe laid for the special service of any of the public buildings.

Although all the mains in the table apparently come within the purview of the law referred to by the Commissioners, the United States has, as a general rule, not been at any expense on account of the mains 12 inches in diameter and under for many years. They have probably been considered and used as belonging to the general distribution system of the District of Columbia and have been cared for at the

expense of the District. The District authorities, with but one exception, as far as I am informed, have therefore not applied for or been granted authority for any of the thousands of taps that probably exist in these mains.

I know of no reason why, with three exceptions, they should not all be formally turned over to and be accepted by the District of Columbia, as, by authority of the Secretary of War in 1891, was done with the large number of valves placed by me on the outlets from the 48-inch and other large mains laid by the United States under the act of August 2, 1889, or, if this be not deemed advisable, why general authority should not be given the Commissioners to tap the small mains referred to.

These exceptions are, that part of the 10-inch main in Georgetown mentioned in a note to my tabular list of mains and for the reasons stated in the note, the 12-inch main on the Conduit road between the distributing reservoir and Foxall Hill, and the 12-inch main on the Canal road.

The 12-inch main on the Conduit road between the distributing reservoir and Foxall Hill is parallel to and near the 48-inch, 36-inch, and 30-inch mains. It is very deep (18 feet on a part of its route); it is very expensive to get at the main for tapping, and the great excavations required for this purpose endanger the large mains. The land on both sides of the road is being built upon, and improvement in the vicinity and applications to tap the main are likely to rapidly increase in number by reason of the probably early construction of the Washington and Great Falls Electric Railway, recently chartered by Congress. If the District authorities should lay a small distributing main on this road between the points mentioned, no further tapping of the 12-inch main on this part of its route except for connecting it with the suggested distributing main would be required, and the danger to which the large mains are now subject would be avoided.

The 12-inch main on the Canal road is also very deep, and for a considerable distance the 48-inch and 36-inch mains lie between it and the houses on the north side of the road, so that it is now necessary, whenever additional houses are to be supplied with water, to run the service pipes from the 12-inch main under these two large mains, for the reason that the top of the 48-inch main is so near the surface of the ground that service pipes if carried over the main would be likely to freeze in very cold weather. This practice endangers the water supply to the city. Some time since I found a plumber, acting under the authority of a permit given by the District water office to tap the 12-inch main for the supply of a row of houses of narrow fronts on this road, excavating, apparently without any supervision, a series of tunnels (one for each service pipe) under the 48-inch main, leaving it supported only by narrow benches of not very compact earth. The internal pressure on the mains on this part of their routes is about 43 pounds per square inch (nearly 40 tons to the running foot of 48-inch main), and the plumber was ignorant or regardless of the fact that if either of the 48-inch or 36-inch mains had settled and broken at its joints by a failure of the benches of earth to support it, not only the supply to the city through the main would have been cut off, but the damage to the road, the houses in the vicinity, and the Chesapeake and Ohio Canal on the south side of the road, would have been enormous. There is therefore also required a small distributing main along the Canal road between Foxall Hill and the foot of M street at the Aqueduct (Arlington) Bridge for the supply of the houses on this road, and if this be laid no further tapping of the 12-inch main on this part of its route except for the supply of this distributing main would be necessary.

In view of the foregoing, I have to make the following recommendations:

First. That the Commissioners of the District of Columbia be tendered a transfer to the District of all the United States mains in the District of 12 inches in diameter and under, with the exception of the 10-inch main in Georgetown between its valve just north of M street and the Rock Creek Aqueduct Bridge at Pennsylvania avenue; the 12-inch main on the Conduit road between the distributing reservoir and Foxall Hill, and the 12-inch main on the Canal road; or if this be deemed not advisable, then I would recommend that general authority be granted to the Commissioners to tap any of these mains at their pleasure, with the exceptions just mentioned.

Second. That the Commissioners of the District of Columbia be requested to lay a distributing main on the Conduit and Canal roads between the distributing reservoir and the foot of M street at the Aqueduct (Arlington) Bridge across the Potomac, and that if this main be laid and it be requested by them, permission be granted the Commissioners to tap the 12-inch main for the supply of this distributing main.

An earlier report on the letter from the Commissioners has been prevented by the uncertainty as to accuracy of the plats of the old United States mains and by my other duties.

The letter is herewith returned.

Very respectfully, your obedient servant,

GEORGE H. ELLIOT,
Colonel of Engineers.

Brig. Gen. THOMAS L. CASEY,
Chief of Engineers, U. S. A., Washington, D. C.

APPENDIX C C C.

IMPROVING THE DALECARLIA RECEIVING RESERVOIR, DISTRICT OF COLUMBIA.

REPORT OF COL. GEORGE H. ELLIOT, CORPS OF ENGINEERS, RETIRED, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1895.

OFFICE OF THE WASHINGTON AQUEDUCT,
Washington, D. C., August 1, 1895.

GENERAL: I have the honor to transmit herewith report of operations for the improvement of the Dalecarlia Receiving Reservoir, District of Columbia, for the fiscal year ending June 30, 1895.

Very respectfully, your obedient servant,

GEORGE H. ELLIOT,
Colonel of Engineers, Retired.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

This reservoir is partly in Montgomery County, Md., and partly in the District of Columbia. It was constructed with a capacity of about 170,000,000 gallons of water.

In this my final annual report on this improvement, I think it proper to restate its object and the project for the work.

Its object was to divert from the reservoir the water flowing from its watershed, which has an area of about 4,000 acres.

When the reservoir was constructed by the late General Meigs about thirty-five years ago for the storage and settling of Potomac water from Great Falls, the land comprising its watershed being then sparsely settled and largely occupied by woods, and its cultivated land being mainly used for grazing purposes, the water from it was not excluded from the reservoir, and, mixed with Potomac water, which entered the reservoir through the "north connection," it was used in the Washington water supply for more than twenty-five years. In time, however, as the country surrounding the reservoir became more populated, the water flowing from it into the reservoir became more and more contaminated, and frequent complaints by citizens and in the press led to the reservoir being thrown out of service about seven years ago.

The water from the watershed entered the reservoir by three streams, viz, Little Falls Branch, Mill Creek, and East Creek, these streams having drainage areas of about 2,700, 900, and 225 acres, respectively.

The project for the improvement of the reservoir* provided for the erection of dams across the valleys of all of these streams just above their mouths and taking the water of East Creek (the stream farthest to the east that polluted the reservoir) from behind its dam and conducting it by an open channel around the margin of the reservoir, together with the water flowing directly into the reservoir from the hillsides between East Creek and Mill Creek, into Mill Creek above its dam. The combined waters of both streams and the water falling directly into the reservoir from the hillsides between Mill Creek and Little Falls Branch were to be carried by a proportionally larger channel, still following the margin of the reservoir, and a short tunnel into Little Falls Branch. Finally the water of the entire watershed thus collected was to be turned into a shaft to be excavated in the valley of the latter stream above its dam, and from the bottom of this shaft a tunnel about 1,000 feet long, to be excavated under Dalecarlia Hill and under Washington Aqueduct Tunnel No. 4, was to carry the water to a natural water course below the reservoir in which it would flow off into the Potomac.

At the commencement of the last fiscal year the tunnel under Dalecarlia Hill and the shaft in the valley of Little Falls Branch, which is 51 feet deep (56 feet to the bottom of its water cushion), had been essentially completed and work had been suspended until the new appropriation should become available.

In the act of August 7, 1894, Congress granted an appropriation of $52,500 for continuing the work, and operations were resumed on the 15th of that month. The excavation of the tunnel through the hill east of Little Falls Branch was then commenced and it was soon carried to the limits of the Government land. By reason of the delay of the district attorney for Maryland then in office, in reporting on the validity of the title to the land purchased for the remainder of this tunnel, its excavation was suspended from the 4th of September until the 18th of December. This unfortunate and unlooked for delay having come to an end, the excavation of the tunnel was resumed and work was carried on night and day with three shifts of workmen at each end until the 16th of January, when the headings met.

In addition to the appropriation just mentioned, the sum of $37,500 was appropriated for the work in the act of March 2, 1895, and by the terms of the act the money was made immediately available.

Under these two appropriations as large a force of workmen has been constantly employed as could be worked to advantage, the number for several months past averaging from 150 to 250 men.

In addition to the excavation and lining of the tunnel about 400 feet long through the hill east of Little Falls Branch, the following work has been done since my last annual report:

Grading the slopes and completing the walls of the channel leading from Wasteweir No. 2 of the Washington Aqueduct at the mouth of the new tunnel under Dalecarlia Hill; the construction and paving of the open channels around the reservoir, of which the aggregate length is 4,869 feet, or nearly 1 mile; the excavation and paving of gutters on the hillsides above these channels to prevent erosion of the banks of the channels; the construction of the following earthen dams, viz, the dam across the mouth of Little Falls Branch, 230 feet long and 10½ feet high, its crest being at reference (157); the dam across the mouth of

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*A plan of the works and a map of the watershed of the reservoir were printed in the Annual Report of the Chief of Engineers for 1893, pages 4308–4309.

Mill Creek, 325 feet long and 15 feet high, its crest being at reference (158.1), and the dams across the two branches of East Creek, with lengths of 58 and 16 feet, respectively, their crests being at references (167.3) and (167.8), respectively; the driving of piles for 491 feet of sheet piling through the permeable material to hard rock in the valleys of Mill Creek and Little Falls Branch at the sites of their dams, and the numerous preliminary borings required for this work; the quarrying at the quarry on the reservoir land of the stone required for the facing of the portions of the sides of the Mill Creek Dam to be exposed to wind waves in the reservoir and in the pond behind the dam, and the laying of this facing; the construction—partly in concrete, the major part in Georgia pine timber—of a flume about 70 feet long 10½ feet wide and 7 feet high, extending out from the portal of the main drainage tunnel on the south side of Dalecarlia Hill; the construction of heavy retaining walls at the portals of the tunnel through the hill east of Little Falls Branch; the clearing of trees from the sites of the channels around the reservoir and in the portion of the valley of Mill Creek to be overflowed by reason of the construction of the dam across this creek, and the hauling and burning of the large amount of brush from the trimming of these trees;* the construction of two permanent wagon bridges in the valley of Little Falls Branch near the west portal of the tunnel through the hill east of this valley, which bridges were made necessary by changing the courses of Mill and East creeks; the construction of a heavy retaining wall on the hillside of the shaft in the valley of Little Falls Branch and the completion of the lining of the shaft by its stone coping; the construction of a concrete stop wall on the valley side of this shaft, the excavation for which wall was carried through the soft rock to solid rock with side walls extending to the solid rock in the hill in rear of the shaft, and the construction also at this shaft of a heavy iron grating for preventing the shaft and the tunnel leading from the bottom of the shaft from being obstructed by logs and driftwood in floods; fencing in with a strong wire fence nearly 2 miles long the various parts of the work, and especially on the northerly and easterly sides of the reservoir land, for the purpose of excluding animals from the slopes of the open channels around the reservoir and the slopes of the dams, all of which slopes have been carefully covered with soil and planted with grass seed; the paving with vitrified brick the channel approaches to the east portal of the tunnel through the hill east of Little Falls Branch and the shaft in the valley of that stream; the reexcavation of the old channel from the "north connection" into the reservoir, by which the reservoir was formerly supplied with Potomac water from Great Falls, and which had become entirely filled up with detritus brought down by Little Falls Branch after the use of the reservoir was suspended,† and excavating to refer-

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*The hauling of this brush to distant points, where it could safely be burned without endangering the fine woods around the reservoir, was very expensive, and more than $1,100 was paid for this item and for burning the brush. The brush could not be left on the ground for fear of accidental fires and fires set by tramps.

†The sill of the outlet from the "north connection" is at reference (134.75), but on account of the bad condition of the by-conduit, which, at its upper end, is very near this channel and the invert of which is at reference (135), and of the danger of increasing the flow of water from its numerous leaks, and thereby undermining the by-conduit and cutting off the water supply to the city during the excavation of the channel, I deemed it unsafe to excavate the channel below reference (137.75). Subsequently, and when emptying the reservoir for the purpose of refilling it with Potomac water, the by-conduit gave way, as mentioned elsewhere in this report, but not at this place, which was apparently its weakest point. Before this happened

ence (140) the upper end of the reservoir, which had shoaled from the same cause. The total amount of these excavations was about 9,500 cubic yards.

To the foregoing work, executed since my last annual report, should be added the surveys required for the work of improvement; the surveys of the nine additional parcels of land required to be purchased for the work; the construction of a telephone line, and the construction of the necessary roads, and the cutting and planting of boundary stones.

The water of Little Falls Branch was turned from its channel into the shaft in the valley of the branch above its dam on the 23d of April. The larger of the two branches of East Creek was turned into its new channel on the 15th of May, and the smaller one into its new channel on the 22d of May.

The only thing necessary to be done to complete the diversion from the reservoir of the water from its entire watershed, except some small areas under the control of the United States, was the closing of the by-pass or cut in the hillside at the north end of the Mill Creek Dam through which the water of the creek passed into the reservoir during the construction of the dam. This was a delicate operation that had to be done under the protection of a small temporary dam while the water of the creek was rising to the height of its new channel into the valley of Little Falls Branch, but it was successfully accomplished on July 26, and from that day all the water of East Creek, Mill Creek, and Little Falls Branch, and all the water of the entire watershed, except the small areas under the control of the United States, passed around the reservoir and through the tunnel leading under Dalecarlia Hill, and the object of our two years' work was accomplished. In anticipation of this event all but a small portion of the contents of the reservoir had been drained out through the valve in the sluice tower. I then ordered the running off of the remainder, preparatory to the refilling of the reservoir with Potomac water from Great Falls, which was to be done under the direction of Major Knight, the officer in charge of the Washington Aqueduct. It was to be done slowly through the "south connection" by means of the excess of the daily supply from Great Falls above the requirements of the city, and so that it would not inconvenience citizens on Capitol Hill and other high parts of Washington.

When the emptying of the reservoir had been essentially completed (July 27) the by-conduit which passes around the reservoir and through which the supply to the city had been kept up during the improvement of the reservoir (and in fact since 1888), gave way under the pressure of the water in the conduit at a point a short distance east of the wasteweir, and the entire flow from Great Falls was discharged into the reservoir, which has thus been brought into use a few days earlier than was anticipated.

The by-conduit, which is about one-half mile long, was constructed by Civil Engineer Silas Seymour after General Meigs left the Aqueduct and during the time when, in the late civil war, the Aqueduct was under

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it was observed that the sides of the channel were, at some points, slipping down and forcing up its bottom. The side slopes are very gentle (1 on 3), but the clayey deposit through which the channel was excavated has very little stability. As soon as the by-conduit broke the refilling of the reservoir commenced. This was a few days earlier than was intended, and it was too late to remedy this shoaling of the channel. When the water in the reservoir rises sufficiently it is probable that the shoaling will cease, but if it should continue to a degree to interfere with the flow from the "north connection" into the reservoir, the shoal will have to be removed, and the only means of doing this will be by dredging and boating the material to the wasteweir, over which it can be pumped into the spillway passing under the "White Bridge."

the Department of the Interior. It was a useful work, but it has been in a leaky condition for several years. It was badly built and too near the margin of the reservoir. It should be rebuilt farther back from the reservoir in solid ground and for the purpose for which it was originally constructed, viz, that the water from Great Falls may be run directly into the distributing reservoir or through the Dalecarlia Reservoir, as may be desired.

A considerable amount of work—that the running of the water in its new channels and to the shaft will not interfere with—yet remains to be done in filling the gap in the Little Falls Branch Dam left for hauling material for facing the slopes at the upper end of the reservoir; in completing the north end of the Mill Creek Dam and the stone facing at the outlet end of the channel leading into Mill Creek from East Creek; in completing the work on the bridges near the east portal of the tunnel under the hill east of Little Falls Branch, and at various other points on the line. About 90 men are still employed, and it is expected that all these odds and ends of work will be fully completed in a month or six weeks.

Favorable results of the examinations of title by the United States district attorney for Maryland and the decisions thereon of the Attorney-General of the United States in the cases of the lands purchased are daily expected, and as soon as received these lands will be paid for.

Proceedings in condemnation in the cases in which no agreements as to price of lands could be had will be instituted as soon as the deeds for the lands purchased are obtained, until which time it has been deemed best for the public interests to delay these proceedings.

One result of the improvement of the reservoir is the doubling of the capacity for the storage of Potomac water from Great Falls, and another result is that the detritus brought down by the streams is now carried with the storm waters into the shaft in the valley of Little Falls Branch, and thence through the tunnel under Dalecarlia Hill and off into the Potomac. This detritus probably amounts to thousands of tons annually. It had materially shoaled the reservoir (when the reservoir was constructed the flow line extended up Little Falls Branch as far as the old bridge recently removed), and in time would have ruined it.

In addition to these results it is expected that the increased time for sedimentation furnished by the slow passage of water through this long reservoir will materially improve the quality of the water after heavy storms in the valley of the Potomac, although it is not expected that anything short of filtration works will at such times clear the water of all of its clayey matter or materially improve its color.

In concluding this report I should remark that although the channels and tunnels were designed in excess of the dimensions required to carry the water from the watershed of the reservoir, under the extreme supposition of a rainfall of 1½ inches per hour for several successive hours (that is to say 110, 308, and 714 cubic feet per second in East Creek, Mill Creek, and Little Falls Branch, respectively, 1,132 cubic feet in all, or more than the entire low-water flow of the Potomac at Great Falls) I am satisfied from my experience, and especially from two exceptionally heavy showers this summer, that the rainfalls in the vicinity of the reservoir are at times, and for short periods, heavier than in Washington or any other place on the line of the Aqueduct between Great Falls and Washington, and that the channels and tunnels are none too large.

As stated in my last annual report, the grades and cross sections of the open channels around the reservoir were so calculated that when the channels run full (as they will, within a foot of the tops of the banks, if the heavy rate of rainfall provided for should ever be reached) the mean velocity of the water in each case will be about 4 feet per second. Grades and cross sections that would give greater velocities would not be prudent on account of liability to erosion of the channels. When the channels do not run full, or nearly full, during the major part of the year there will be but a few inches of depth of water in the channels, the mean velocities will be less, and it is likely that deposits will be made and bars formed, but this is a danger that can not be avoided in streams so changeable in depth.

In respect of the tunnels, the grades were calculated so that under ordinary conditions of flow the velocities would not be so high that gravel and sand transported along the bottoms of the tunnels would rapidly wear the inverts of the linings (which nothing short of cast iron would prevent in case of high velocities long continued), while at the same time the velocities would be sufficient to prevent deposits, and it was expected that if deposits should be formed during periods of low water the flow following the next heavy rainfalls would quickly remove them.

There is danger, however, if the tunnels are left unwatched and uncared for that some great and sudden freshet following a long period of low water may find a depth of deposit that will interfere with the free discharge through one or both of the tunnels required to prevent such a backing up of the water as to overflow and wear away the dams and channel banks. To run no risk in this regard, it will therefore be safe to remove from time to time by barrows all considerable deposits in the tunnels, if such be found.

I desire therefore to record the caution that, for the safety of the works and to prevent serious injury to them by the overflow of the channel banks and the dams, the most faithful and conscientious attention on the part of the watchman in charge of the reservoir will be required to daily inspect the valleys of all the streams within reasonable distances above their dams and remove out of reach of the water in floods everything liable to float and make obstructions anywhere on the line of the works; to keep the channels and the gutters above the channels clear of deposits and sand bars and other obstructions; to keep the banks of the channels and the dams in good order; to watch the head of the tunnel east of Little Falls Branch, and if any logs or other heavy drift should lodge there to quickly remove it; to frequently inspect the tunnels throughout their lengths and to remove from time to time, and at least once in three months (say on the first working day of every quarter), such deposits as may be formed in long intervals between heavy rainfalls; to keep the bed of Little Falls Branch free of weeds and grass so that in floods it will not back up and interfere with the discharge of the tunnel leading into it, and above all, to keep the grating around the shaft in the valley of Little Falls Branch clear of drift-wood and brush in heavy showers and storms and of floating ice in winter. In my judgment the entire time of an energetic and intelligent laborer should be constantly devoted to caring for this work, and the watchman should be authorized to call to his aid at all times in emergencies such additional assistants as he may require.

I desire to renew the expression contained in my last annual report of my indebtedness to Mr. F. W. Johnston, my assistant engineer, at the work, for the very zealous, enthusiastic, and skillful execution of

his duties. Also to Mr. Peter McAtee, my tunnel foreman, who has exhibited rare energy and capacity in the handling of large bodies of workmen; to Mr. Percy Overton, master mason, and to William and Henry Bolac, James P. McAtee, David H. Huston, and Thomas J. Bray, foremen in charge of gangs.

My warmest thanks for his faithful and efficient services are also due to Mr. Pickering Dodge, chief clerk of the Washington Aqueduct, who, until my retirement from active service on March 31, had charge of the accounts of my heavy disbursements on this work, and who has since, by the kind permission of Major Knight, my successor in charge of the Aqueduct, and with the valuable assistance of Mr. Edward Q. Knight, my clerk, continued in such charge.

ADDITIONAL REMARKS.

The paving of the open channels consisted in paving the bottoms and a partial paving of the side slopes.

The aggregate length of these channels is, as I have stated, about 1 mile. The channel carrying East Creek into Mill Creek is 5 feet wide at bottom and 4 feet deep, and the channel from Mill Creek to Little Falls Branch is 9 feet wide at bottom and 7 feet deep, and by reason of the great cost of paving I have limited the paving of the side slopes to the height of 1 foot 6 inches vertically above the bottoms of the channels; this under the consideration that storms that will cause the water to run more than 1 foot 6 inches deep in the channels are so infrequent that the probability is that no greater storm will occur before the slopes above the paving will be sufficiently protected, during the short and rare periods that they will be exposed to erosion, by the sod that covers the tops and sides of the banks of the channels.

In respect of the lands necessary to be acquired for the work, it should be stated that in addition to the five small parcels of land in the vicinity of the reservoir purchased during the fiscal year ending June 30, 1894, for the sites of the works and for the purpose of controlling the drainage of some small areas that were so situated that it could not be provided for by the improvement works, nine small parcels remained to be purchased, viz, two small side valleys owned by the heirs of Charles Shoemaker in the valley of Mill Creek, to be overflowed by the Mill Creek Dam; one parcel on the hill east of Little Falls Branch required for the tunnel under this hill; and six small parcels on the Conduit road, between this road and the reservoir, two of which were owned by R. W. Morgan and the others by R. H. Harper, James Harper, John P. Hickey, and Mary Harrison.

The papers in the cases of Charles Shoemaker, R. W. Morgan, Mary Harrison, and Richard H. Harper are now awaiting the decision of the Attorney-General respecting the validity of the titles. In the cases of James Harper and John P. Hickey it is probable that resort must be had to condemnation, as they so far refuse to take reasonable prices for their lands.

There was leased from W. D. Brooke 3.58 acres of land on the hill east of Little Falls Branch for the temporary buildings required for the work and other purposes.

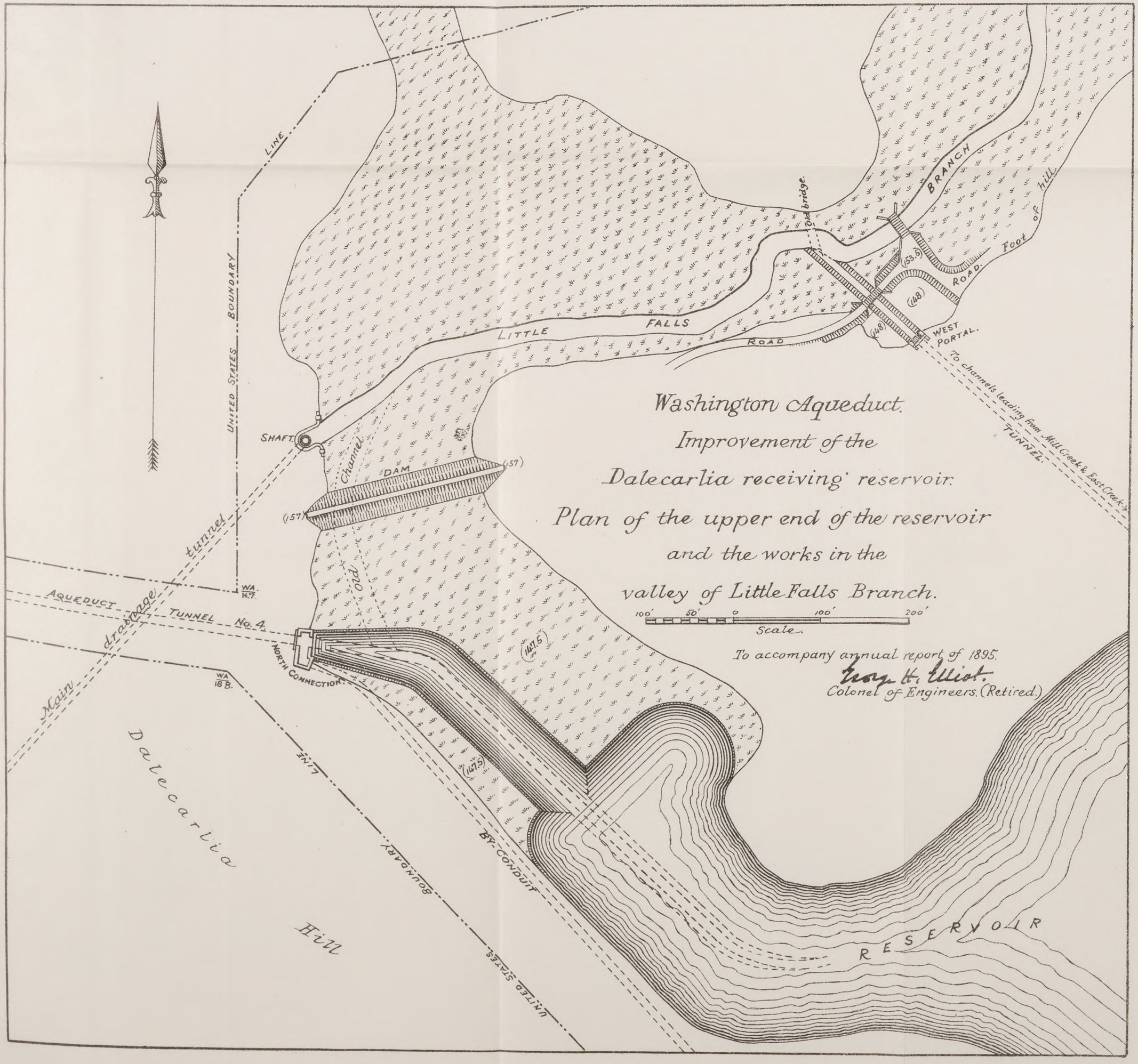
The following contracts were made during the year: With McMahan, Porter & Co., of New Cumberland, W. Va., for vitrified brick; with the Washington Hydraulic Press Brick Co., of St. Louis, Mo., for common brick; and with James H. McGill, of Washington, D. C., for natural hydraulic cement.

I inclose three drawings, viz, plan and section of the shaft in the valley of Little Falls Branch; plan and sections of the east portal of the tunnel under the hill east of Little Falls Branch, and plan of the upper end of the reservoir and the works in the valley of Little Falls Branch.

Money statement.

July 1, 1894, balance unexpended		$1,038.05
Amount appropriated by act of August 7, 1894		52,500.00
Amount appropriated by act of March 2, 1895		37,500.00
		91,038.05
June 30, 1895, amount expended during fiscal year	$58,831.36	
July 1, 1895, outstanding liabilities	6,889.62	
		65,720.98
July 1, 1895, balance available		25,317.07

No further appropriation is required for the work. The money available is abundantly sufficient for its completion and it is expected that there will remain a considerable sum to be covered into the Treasury.



Washington Aqueduct.

Improvement of the Dalecarlia receiving reservoir.

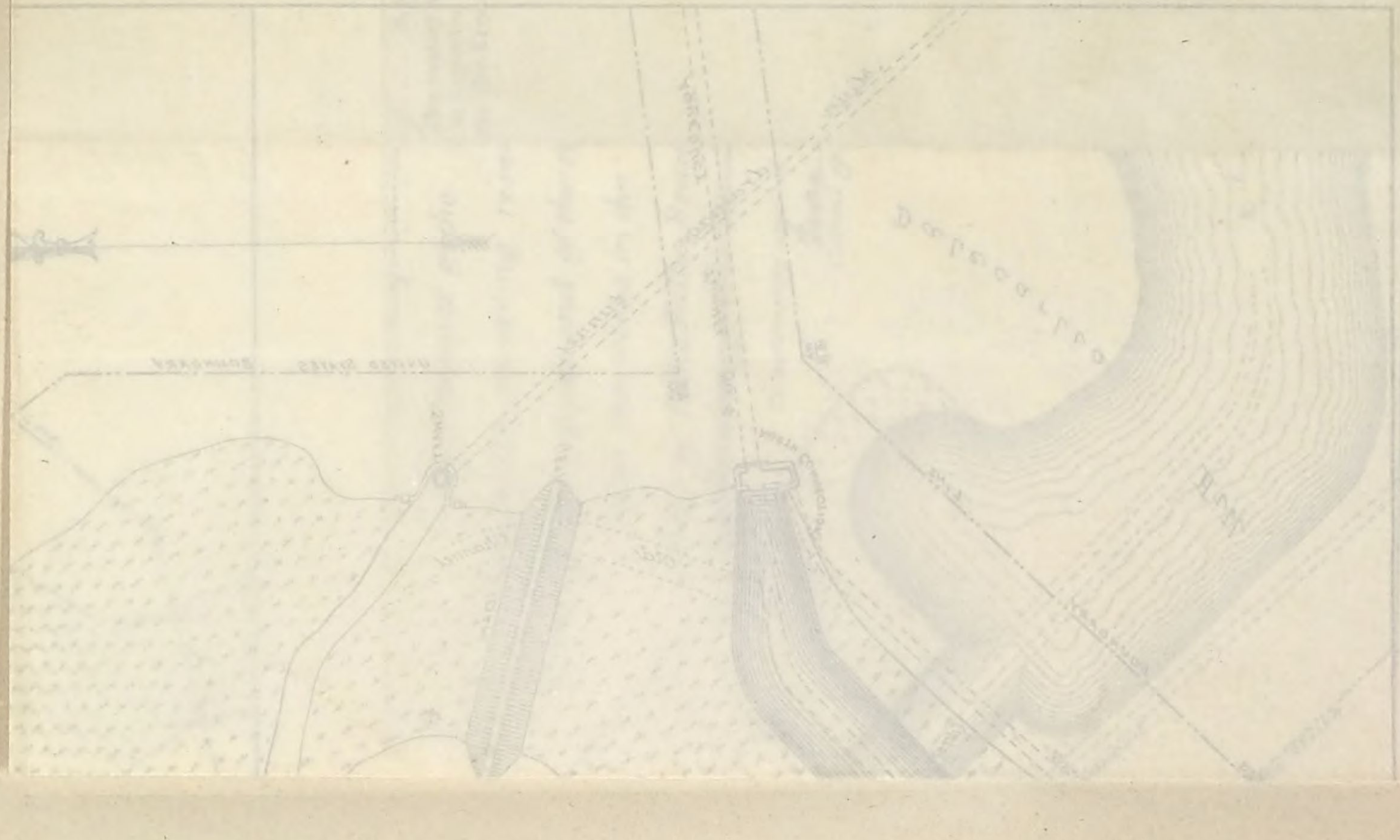
Plan of the upper end of the reservoir and the works in the valley of Little Falls Branch.

100' 50' 0 100' 200'

Scale.

To accompany annual report of 1895.

Geo. H. Elliot.
Colonel of Engineers. (Retired.)



Washington Aqueduct.

Improvement of the

Dalecarlia receiving reservoir.

Plan and sections of

East Portal of tunnel

under hill east of Little Falls Branch.

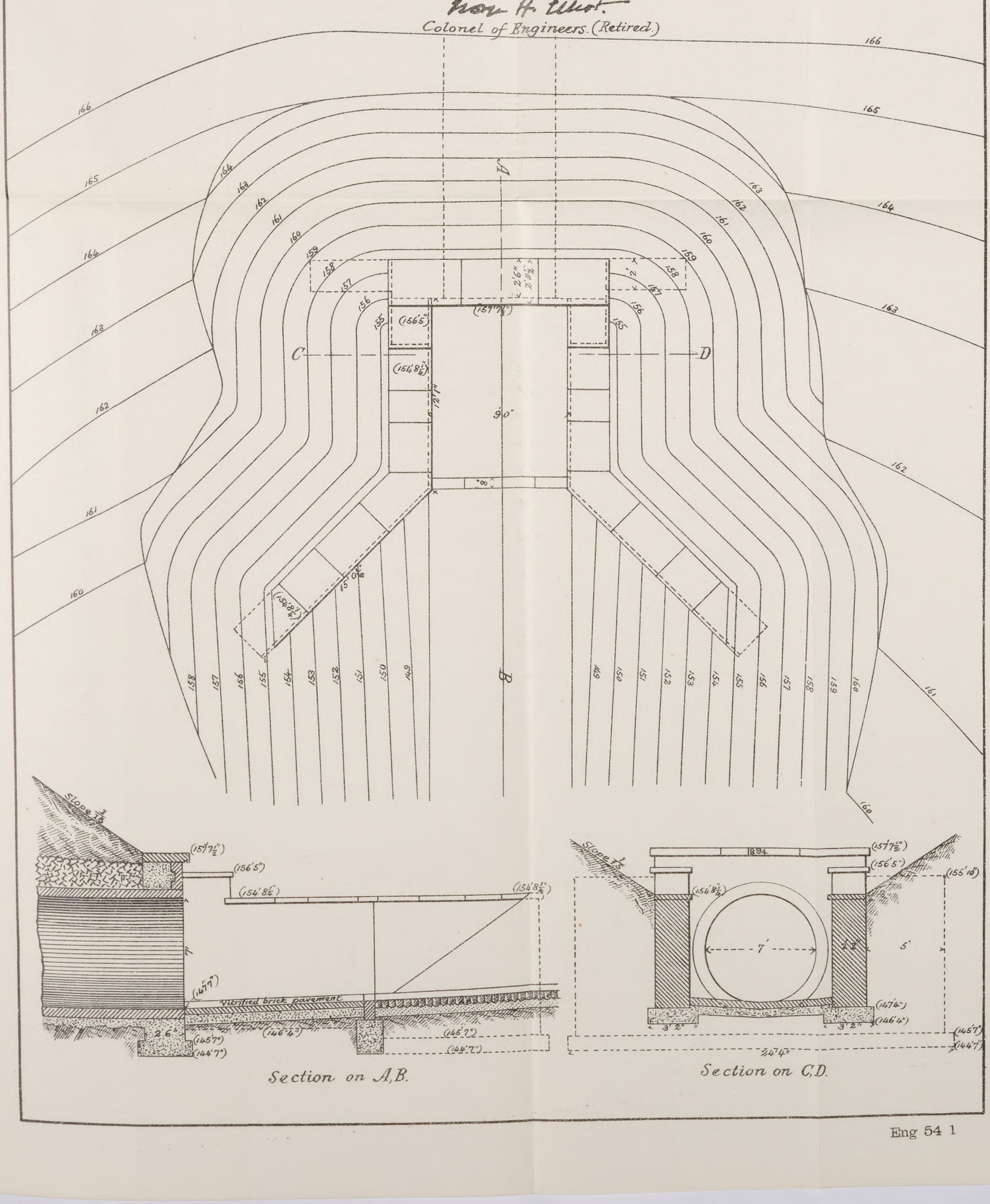
10' 5' 0 10'

Scale.

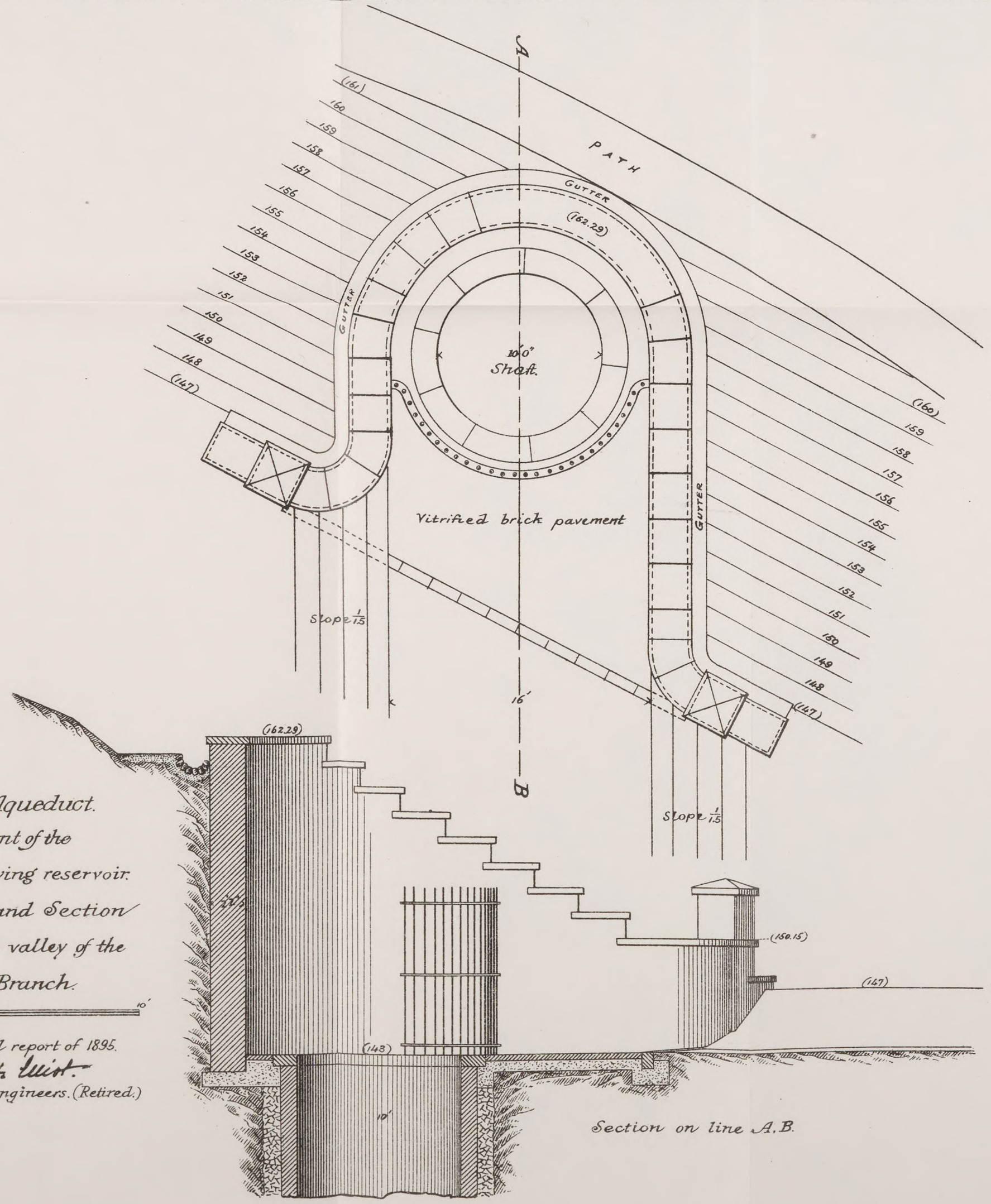
To accompany annual report of 1895.

Thos H. Elliot

Colonel of Engineers. (Retired.)



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Washington Aqueduct.

Improvement of the Dalecarlia receiving reservoir.

Modified Plan and Section of the shaft in the valley of the Little Falls Branch.

To accompany annual report of 1895.

Geo. H. Elliot.

Colonel of Engineers. (Retired.)

Section on line A.B.

APPENDIX D D D.

IMPROVEMENT AND CARE OF PUBLIC BUILDINGS AND GROUNDS IN THE DISTRICT OF COLUMBIA—WASHINGTON MONUMENT.

REPORT OF COL. JOHN M. WILSON, CORPS OF ENGINEERS, OFFICER IN CHARGE, FOR THE FISCAL YEAR ENDING JUNE 30, 1895.

OFFICE OF PUBLIC BUILDINGS AND GROUNDS.
Washington, D. C., July 5, 1895.

GENERAL: I have the honor to submit the following report of operations upon public buildings and grounds in the District of Columbia, under the Chief of Engineers, during the fiscal year ending June 30, 1895.

In addition to these duties, I am a member of the Light-House Board, and have been in charge of the erection of a monument to mark the birthplace of Washington, and the construction of an iron-pile wharf at the mouth of Bridge Creek, Virginia.

PUBLIC BUILDINGS.

EXECUTIVE MANSION, GREENHOUSES, AND STABLE.

In addition to the usual care extended to the mansion and its furniture, the following has been accomplished during the year:

The entire exterior of the mansion, including walls, roof, windows, doors, balconies, railing, columns, ceilings of balconies, etc., has been repainted.

The elevator, the furnaces, grates, ranges, water tanks, etc., have been overhauled, cleaned, and repaired.

A very slight, almost imperceptible, settlement was discovered in the iron tank upon the roof; the underpinning was carefully examined, floor of attic torn up, a new truss placed between floors and under ceiling, additional girders and bracing added, and everything rendered absolutely secure.

The attic window sash and shutters were repaired and repainted.

The entire electric-light and gas system was overhauled, several new incandescent lights placed in position, all chandeliers thoroughly cleaned and the old closed globes upon those in the lower main corridor replaced with new open globes.

Every chimney in the house has been swept and the sheet-iron chimney caps repaired and replaced where found to be damaged.

The walls of the basement and its corridor, have been whitewashed, and the kitchens, woodwork of basement corridor and outside of west entrance repainted.

The entire office section of the building has been repainted where necessary.

The east room, green and blue parlors, and main corridor have been repainted and regilded, and the state dining room, butler's pantry, small reception room, and main vestibule repainted.

The tile floor of main vestibule has been repaired.

Repairs were made to the woodwork and plastering of linen closets between first and second floors.

On the second floor all bedrooms have been repainted where necessary and all tables revarnished.

The ceiling of blue bedroom has been repaired and repapered, and the northeast bedroom repapered; the furniture in the blue bedroom and northwest bedroom has been reupholstered.

A new bathroom has been constructed opening into northwest bedroom.

Extensive repairs have been made to the girders and the floor of the north bathroom.

In the red parlor, the southeast window has been cut down to the level of the balcony and a glass door constructed.

New carpets have been placed in the blue parlor and in two bedrooms; the old carpet from the blue parlor has been fitted and placed in two bedrooms, and the other old carpets sold at auction and the proceeds turned into the United States Treasury.

New furniture was purchased for the lower corridor, the old furniture being placed in other portions of the house; the furniture in the green parlor was reupholstered and the old drapery replaced with new.

New bedsteads and mattresses were obtained for the northeast bedroom.

New lace curtains were purchased for the blue parlor, private dining room, library, and two bedrooms, to replace others worn-out and worthless.

Celluloid flowerpot covers were obtained for decorative purposes at official receptions.

Some additions were made to the china, glass, linen, and silver used at official receptions.

All windows and doors throughout the house were carefully examined, doors were eased or rehung, locks repaired, broken window cords and glass renewed, and storm sash placed upon the south and west windows.

The chairs in the state dining room, private dining room, and hall have been repaired and reupholstered where necessary.

In the autumn of 1894 all carpets were relaid and curtains rehung, and in the spring of 1895 the carpets, amounting to about 3,000 yards, were taken up, cleaned, and stored, and the house placed in summer costume.

The conservatory and the other greenhouses received such necessary repairs as the funds available would admit; the south side of the conservatory was strengthened by removing old timber, placing 108 feet of 8-inch iron beams upon the columns, erecting thereon a 9-inch brick wall 1 foot high, and constructing new cornice; a portion of the old wooden substructure on the north and west side was removed and replaced with stone.

The old decayed superstructure of the south section of the camelia house was removed and replaced with a handsome iron superstructure, and the house fitted with proper stone benches and heating apparatus.

All boilers, furnaces, stoves, pipes, chimneys, etc., were cleaned, repaired, and placed in as good order as possible.

Attention is again invited to the conservatory, the frame of which is of wood, rapidly decaying, and almost in a dangerous condition. A new iron superstructure, at an estimated cost of $13,000, is necessary.

Annual repairs are made to the old superstructure, but it seems almost a waste of funds to patch up portions of an old, decayed wooden frame with wood, which will also decay, when a violent storm might possibly wreck the structure at any time.

Necessary attention has been given the valuable collection of plants in the greenhouses, a large number of bedding and greenhouse plants propagated, and several thousand spring flowering bulbs planted under glass and in the grounds for decorative purposes.

Some minor repairs were made to the stables.

Attention is again invited to the importance of providing suitable offices outside the Executive Mansion for the President of the United States. This matter was discussed in my annual reports for 1893 and 1894.

I earnestly recommend that an appropriation of $250,000 be made for the erection, within the Executive Mansion grounds and directly opposite the Treasury building, of a granite structure for offices for the Chief Executive of the nation.

This structure could be connected by a wide corridor with a large conservatory, fitted up as a winter garden with tropical plants, fountains, and statues of eminent Americans; the conservatory could open into a picture gallery connected by two wide corridors with the east room, and these improvements could serve a double purpose by relieving the mansion of the terrible crush incident to the evening official receptions.

I earnestly hope that this important matter may no longer be delayed and that action may be taken at the approaching session of Congress toward erecting a suitable office building for the President of the United States.

WASHINGTON NATIONAL MONUMENT.

Every effort has been made during the year to maintain the Monument and its machinery in good condition.

Vandals continue to give annoyance by occasionally chipping pieces from the outside or from memorial stones in the inner walls; whenever detected these thoughtless persons are arrested, but as a rule, when brought to trial, escape with a small fine.

The elevator and all the machinery connected therewith has been carefully and critically inspected monthly by an expert from the Otis Elevator Company and pronounced in excellent condition. Weekly inspections are made by the principal steam engineer and machinist at the Monument, and daily tests of the safety appliances of the elevator are made by the employees before starting to convey passengers to the top. It is believed that the elevator is as safe as it is possible for man to make it, and every effort is made to prevent accidents. Should an accident ever occur it will result from something which it was impossible to foresee.

During the latter part of August the grounds around the Monument were occupied by the Knights of Pythias, in accordance with an act of Congress, and although over 30,000 people visited the Monument during the last week of August there was no occasion to make an arrest for any cause whatever.

From time to time repairs were made to the steam pipes in the tunnel between the boiler house and Monument, and 735 linear feet of the steam pipe was incased in sectional magnesia covering. The result of this covering was so satisfactory that it will be applied to the entire pipe when funds are available.

During the month of December, 1894, the boilers were overhauled, crown sheets repaired, new arch plates placed in furnaces, and new tubes placed in feed-water heater.

The steam trap at bottom of tunnel shaft was repaired and the injectors in boiler house overhauled.

The side walls of furnaces were repaired and the piston rods and valve stems of the elevator engines were packed.

The Monument and boiler house were connected by telephone.

A new 6 by 6 inch Ideal engine was placed in position to drive the dynamo, and the old worn-out engine removed.

Minor repairs have been made to the woodwork of windows and doors in the Monument and to the floor of the engine room.

The roof of the lodge house has been repaired and painted and the doors and window casings have been painted.

A portion of the ironwork between the top and bottom of the shaft has been repainted.

The Monument was open daily during the year, except Sundays and holidays, and with the exception of a few days in the autumn and again in the spring, while the machinery was being overhauled. The elevator was in operation whenever the Monument was open.

There were 159,707 visitors to the top of the Monument during the year, of which number 107,855 made the ascent in the elevator and 51,852 by the stairway, making 1,098,126 persons who have visited the top, without a single accident of any kind, since the shaft was opened to the public, October 9, 1888.

BUILDINGS OCCUPIED AS OFFICES BY THE WAR DEPARTMENT, EXCEPT STATE, WAR, AND NAVY BUILDING.

Under date of June 30, 1893, this office was charged with the preservation, care, and safety of the following buildings:

Army Medical Museum.

Fifth and sixth stories Union building, G, between Sixth and Seventh streets, occupied as offices by Record and Pension Bureau.

Ford's Theater building.

Annex to Ford's Theater building.

Upper stories of West End National Bank, occupied as offices by Signal Department, U. S. Army.

No. 610 Seventeenth street, occupied as offices by Record and Pension Bureau.

No. 1725 F street, occupied by War Department printing office.

No. 1744 G street, occupied by Rebellion Record Office.

No. 1814 G street, occupied by Medical Department, U. S. Army.

Annex to Winder Building, occupied for storage purposes by Ordnance Department, U. S. Army.

War Department stables.

A careful and critical examination was at once made of all these buildings, and plans prepared showing the safe loads that could be carried by each floor of each building.

Where the floors were overloaded the weight was at once reduced to the safe load,

The upper stories of West End National Bank building, occupied by the office of the Chief Signal Officer, were vacated on June 30, 1894, and the fifth and sixth stories of the Union Building, on G street, which were occupied by the Record and Pension Bureau while the repairs of Ford's Theater building were in progress, were vacated on July 31, 1894, and were no longer under the supervision of this office.

All of the other buildings have been inspected at least once each month during the fiscal year, and are believed by me to be in a perfectly safe condition for the purposes for which they are occupied.

The ordinary minor repairs required from time to time are made under the direction of the chief of the supply division of the War Department and paid for from the regular appropriation for contingent expenses of the War Department and its bureaus.

FORD'S THEATER BUILDING.

This building was placed in my charge on June 30, 1893, three weeks after the collapse of a portion of it had taken place.

Under the terms of the act of Congress approved September 7, 1893, operations were inaugurated September 20, 1893, for the purpose of restoring the building to its original condition, and the work was practically completed December 31, 1893.

By act of Congress approved March 12, 1894, an appropriation of $11,958 was made for strengthening and improving the building in accordance with the report of a Special Board of Engineers dated December 30, 1893.

Operations were commenced upon this portion of the work on March 31, 1894, and, as indicated in my last annual report, were in progress at the close of the fiscal year ending June 30, 1894.

During the present fiscal year the area walls on the east side were constructed, the floor of area concreted, the carpentry and steam-heating work completed, iron gratings placed over the east area, the tile and wooden floors repaired, a large coal vault constructed in the alley in rear of building, all wood and iron work of the main building painted, the ceilings and side walls of the second and third stories calcimined and the structure finished, so far as work under this office was concerned, and transferred to the Chief of the Record and Pension Office on July 26, 1894; it was immediately thereafter occupied for office purposes.

IMPROVEMENTS AT THE GOVERNMENT PRINTING OFFICE, INCLUDING NEW STRUCTURES, ADDITIONS, AND ERECTION OF FIRE ESCAPES.

By the act of Congress approved August 18, 1894, an appropriation of $75,000 was made—

> To enable the Chief of Engineers of the Army, under the direction of the Joint Committee on Printing, to repair the Government Printing Office, provide fire escapes, and put said building in a safe and secure condition, and to enable the Public Printer, under the direction of the Joint Committee on Printing, to rent, if necessary, any buildings for the use of Printing Office.

On the afternoon of August 20, I received instructions from the Chief of Engineers to prepare a project for carrying out this law.

After consultation with the chairman of the Joint Congressional Committee on Printing, the work of investigating the exact condition of the building and the preparation of a project of improvement was at once commenced, and on August 31 I submitted a detailed report to

the Chief of Engineers, giving a statement of the condition of the building and recommending that work be carried on in the order as follows:

First. The repair and strengthening of the H street building.

Second. The construction of an additional story and a new roof on the southwest section.

Third. The erection of a new building between the southwest and south center sections of the Printing Office.

The estimated cost of this work, together with the erection of three fire escapes on the exterior of the main building, authorized by the Chief of Engineers, was about $70,000.

On October 3, 1894, I was notified by the Chief of Engineers that the project for an additional story on the southwest section and for a new structure between the southwest and south center sections had been approved and I was directed to submit plans and detailed estimates for the work, and informed that of the $75,000 appropriated by the act of August 18, $10,000 would be required by the Public Printer and the remaining $65,000 would be available for repairs and improvements.

On October 6, detailed estimates with plans were submitted to the Chief of Engineers for constructing an additional story on the southwest building, and on October 9 I was directed to proceed with the work.

Subsequently, under date of October 26, the Chief of Engineers informed me that all the plans were approved and directed me to proceed with work upon the building as rapidly as good workmanship would admit, in the following order:

First. Erection of fire escapes upon the exterior of building.

Second and third. The addition of another story upon the southwest section and the construction of a connecting building between southwest and south center sections.

Fourth. After the surplus material and weight have been removed into these parts, the overhauling of the girders and columns of the H street building and, in abundant caution, the strengthening of these parts where necessary.

More or less minor delay occurred, in order that we might fully comply with the requirements of the accounting officers of the Treasury in reference to the disbursements, the Auditor on October 18, declining to approve the further advance of funds until direct action had been taken by the Joint Congressional Committee on Printing, and on October 19 the Chief of Engineers personally directed me to incur no obligations in connection with the Government Printing Office, exceeding the amount of $2,000, until authorized by the Auditor.

The matter of disbursements was shortly afterwards settled, and I was then authorized to proceed with work.

Proposals were immediately invited for erection of three fire escapes, and for steel, lumber, brick, cement, tiles, wire lathing, plastering, tin, etc., for the new story for the southwest structure.

During the month of November, 1894, three new fire escapes were erected, two on the H street front and one on the North Capitol street front.

The west section of the southwest structure was vacated by the Public Printer on November 24, and the work of tearing off old roof, constructing false roof, tearing out and rebuilding walls, erecting steel work, etc., was at once commenced.

The winter was more than unusually severe, and much time was lost by storms of sleet and snow and excessively cold weather, but opera-

tions were pushed forward as rapidly as possible, and the entire work practically completed by April 5, 1895.

The fourth floor, covering an area of about 12,000 square feet was transferred to the Public Printer on March 29, and the fifth floor, covering an equal area, on April 6, 1895.

In April an additional flight of stairs was added to the fire escape on west side of building, connecting the fifth story of the southwest section with the H street section.

On March 1, operations were commenced constructing the foundation and piers of the new building between the southwest and south center structures.

This structure was designed as a fire-proof building, five stories high, with steel frame, and covering an area of 23 by 60 feet.

The foundations and piers were completed by hired labor during the month of March, and the work of erecting the steel frame under contract was completed May 10, 1895.

Operations under contract upon the remainder of the work were commenced during the latter part of April, and at the close of the fiscal year the building was nearly completed.

As soon as the surplus material and weight have been removed into the new parts now completed the overhauling of the girders and columns of the H street building, and its strengthening where necessary, will be undertaken as directed by the Chief of Engineers.

By the act of March 2, 1895, an appropriation of $121,121.90 was made—

For the construction by the Chief of Engineers of a fireproof building upon the lot belonging to the United States, now occupied by the stables of the Government Printing Office, according to the plan and specifications of Col. John M. Wilson, of the Engineer Corps, submitted to Gen. Thomas L. Casey, Chief of Engineers, December 17, 1894, and approved by him.

On March 9, 1895, this work was placed in my charge by the Chief of Engineers and I was directed to submit a project and estimate for the work.

Under date of March 18 I presented a detailed project and estimate for a fireproof building, with steel frame, the structure to be six stories high with a roomy basement, the north, south, and west fronts to be faced with extra select brick, sills and lintels to be of stone and the proportion of fancy bricks, terra-cotta moldings, and stone in outer faces to be comparatively small. The plan suggested that the interior should be finished with buff brick, avoiding plaster so far as is possible on account of vibrations to which the building will be subjected.

The floors were to be as free as possible from obstruction by columns, as many large windows placed in position as good construction would admit, and all necessary elevators, outside fire escapes, facilities for heating and lighting, drainage, etc., were to be provided.

This project was approved on March 19, 1895, and the work of preparing detailed plans was at once undertaken and pushed forward as rapidly as possible.

As the original plan, under which the appropriation was made, was very general in character, the engineering labor incident to preparing detailed plans was considerable, requiring numerous calculations and many drawings before proposals could be invited for the steel frame, as required by law.

The stables of the Government Printing Office were vacated on April 30, 1895, and on that day the work of tearing them down was commenced, and the excavation for foundation was begun under contract on May 14, 1895.

Materials for foundation were purchased by contract and the work commenced May 31, 1895, and by the close of the fiscal year the foundation was well advanced.

On May 10, 1895, proposals were invited for the steel frame, amounting to nearly 1,000,000 pounds, and on May 29, 1895, the contract was awarded to Phœnix Iron Company, of Philadelphia, Pa., for the sum of $23,860.32.

It is expected that the work of erecting the frame will be commenced by July 8, 1895, and completed by September 15, and that the brickwork will be commenced in the latter part of July. It is hoped that the structure will be under cover by December, 1895.

Proposals were invited May 21 for brick, lime, cement, sand, lumber, and terra-cotta tiles, and contracts for these materials were made during the latter part of June, 1895.

I can not commend too highly the faithful, efficient, and intelligent work done by Second Lieut. John S. Sewell, Corps of Engineers, in connection with the operations in progress at the Government Printing Office. He has personally made the numerous computations necessary to determine the character of the steel frames; has been at work early and late, frequently devoting his evenings as well as Sundays to the discharge of his official duties, when circumstances rendered it necessary.

IMPROVEMENT OF THE PUBLIC GROUNDS IN THE DISTRICT OF COLUMBIA.

VARIOUS RESERVATIONS.

The area covered by the parks and park spaces in the District of Columbia under charge of this office is about 405 acres, within which there are 13.4 miles of gravel and asphalt walks, covering an area of 16.9 acres, and 7.6 miles of gravel and asphalt roads, covering an area of 33.03 acres.

There are in all 301 reservations, varying in size from a few hundred square feet to 82 acres. These reservations are classified as follows:

	Number.	Acres.
Highly improved	93	350.75
Partially improved	40	5.64
Unimproved	168	48.69
Total	301	405.08

Of these 66 are inclosed with post-and-chain or other low iron fences. In my annual report for the fiscal year ending June 30, 1893, I gave a sketch of the general plan proposed for the completion of the park improvements.

Each year an effort is made to add to the list of improved reservations, but owing to lack of necessary funds the progress is very slow. It is not generally realized how much beauty the smaller spaces are capable of exhibiting should they be brought to their highest condition of improvement. It is in a measure true that the outlay in this development is considerable, but the subsequent maintenance of these spots of beauty in their highly improved condition is comparatively light and not much more than the expense now incurred in mowing their grass surface.

With this report I submit partial estimates for the partial improvement of the following:

1. Reservation No. 19 (immediately north of navy-yard).—At the request of a committee of citizens of the District of Columbia a plan of improvement for this reservation, at an estimated cost of $12,000, has been prepared. The reservation covers an area of about 3⅓ acres. It is located in a section of the city which has not yet been highly improved, and is bounded on the north by the tracks of the Baltimore and Potomac Railroad Company. A side track extends through it to the navy-yard. The adjoining streets are unpaved, no sidewalks have been laid, and the streets bounding the reservation are not curbed on the reservation side. In the western section a narrow stream meanders through a small ravine and finds its outlet in an improvised opening in a street sewer. It will require about 3,000 cubic yards of earth to fill this ravine and bring the reservation to proper grade.

It is proposed to lay sidewalks on the east, west, and south boundaries; to construct gravel walks, lay out lawn plots, and sow with grass seed; to introduce water, construct necessary drains, drain lodges, and gutters; to plant with suitable trees, shrubs, and flowers, and to place eight park lamps in position. Three thousand dollars is requested to commence the work.

2. Reservation No. 20, Howard University Park.—This reservation covers an area of nearly 12 acres; it is located south of the Howard University, between Fourth and Sixth streets. Its improvement has been urged from time to time by prominent citizens, and a plan for its ornamentation is submitted at an estimated cost of $25,000.

The reservation is covered with a native forest growth of large oak trees. The major portion of the ground is a little below grade of the surrounding streets, but is not wet except at the southeast corner of the park, where apparently there are springs. The ground generally slopes toward the south and east and admits of easy surface drainage.

The reservation is admirably located for a public park, for pleasure grounds, games, picnics, etc., and for other assemblages of our people, being within a few squares of the terminal stations of four of our city and suburban street railroad lines, by which any part of Washington and its chief outlying suburban villages can be reached from the park in a comparatively short period of time.

It is believed that if the improvements projected were made, this park would soon become a popular place of resort and relieve the city parks proper, which should receive a higher grade of improvement.

With this object in view, it is designed to preserve as fully as may be practicable the present native forest growth of oaks, which furnish an abundant shade, and to form additional plantings of other varieties of ornamental trees and shrubs, bounding the park on all sides, so that there may be many shaded walks and drives in the summer and autumn, opening out into sunny glades in the more central portions of the grounds. It is proposed to construct gravel walks and roads only; to make but few changes in the present surface grades, terracing the northwest section, where the greatest difference of level exists between the street and park grades; to introduce water for drinking fountains, closets, and irrigation, and to construct such drains to street sewers as are necessary to properly drain the lower portions of the grounds, and to request the District government, which claims control of all streets from building line to building line, to construct sidewalks around the reservation. The park will be lighted by electric lamps. Five thousand dollars is suggested with which to commence the work.

3. Hancock Place (Reservation No. 36, corner Seventh street and Pennsylvania avenue).—This reservation has been selected as the site for the statue of General Hancock, and it is proposed to improve it, at an estimated cost of $3,000, as follows:

To construct a circle of 120 feet in diameter, in which a circular mound 60 feet in diameter will be formed around the pedestal of the statue, the circle and mound to be inclosed with a dressed granite curb.

There will be raised grass plots and a small circular mound at the west end of the reservation, planted in part with low-growing flowering shrubs, forming a foreground of pretty parklets.

The entire pavement within and around the reservation is designed to be of one character, preferably granolithic.

Reservation No. 32 (southeast corner of Pennsylvania avenue and Fourteenth street NW.).—This reservation, covering an area of 16,270 square feet, is in one of the most prominent portions of the city, and a plan has been prepared for its improvement, at an estimated cost of $5,000.

Work was commenced upon it in the winter of 1894–95, and the ground has been graded, some dead trees removed, and a portion of the material purchased for the granite curbing.

It is contemplated to remove all the old soft-maple trees which have outlived their usefulness, to construct a granite coping, to introduce water pipe, construct a fountain with basin, place three large vases at the intersections of walks, to construct granolithic paths, and to plant flowering shrubs and a few trees of medium-sized growth of a decidedly ornamental character.

The sum of $1,500 is requested for this work for the coming fiscal year.

There arestill 168 of these little spaces unimproved throughout the city, and if the general appropriation for various reservations could be increased to $15,000 annually they could be gradually transformed into exquisite little parklets and add greatly to the beauty of our Capital City.

CHILDREN'S PLAYGROUNDS.

By the act of Congress approved August 30, 1890, the officer in charge of public grounds was authorized to set aside a portion of the public grounds for a children's playground, under regulations to be prescribed by him. The southern portion of the Monument park was at once set aside for this purpose, but no regulations were prescribed, as there were no means of carrying them out, no watchmen or policemen having been authorized, and the service of the one watchman on duty at the Monument being needed there to protect the structure from acts of vandalism.

Just complaints were received that the lawns were being destroyed, trees injured, and that the children's playground was overrun by vicious and improper persons. This office has been requested to take action to relieve the grounds of such characters, and has been obliged to call on the District police for assistance.

To protect the improved grounds as far as possible and to prevent serious annoyance to those enjoying the beauty of the park, the playground was transferred in the autumn of 1893 to the site between B street and the main drive north of the Monument. This plot of ground covers an area of about 8 acres and is occupied nearly all the time by men and boys playing football or baseball.

By the act of Congress approved March 2, 1895, the officer in charge of public buildings and grounds was directed to authorize the use of a portion of the grounds within the ellipse south of the Executive Mansion for a children's playground, under regulations to be prescribed by him.

Under the terms of this law it is proposed to authorize the use by children of the grounds within the ellipse for playing tennis, croquet, and like games. Permits will be issued from this office upon written applications countersigned by some reputable citizen who will hold himself responsible that no unnecessary damage will be done and that there will be no violation of the ordinary police regulations.

In response to the request of the citizens' committee of East Washington, and in accordance with the terms of the act of August 30, 1890, I have authorized the use for a children's playground of U. S. Reservation No. 126, at the intersection of Georgia and Virginia avenues.

The reservation covers an area of about 2 acres and is admirably located for a playground.

The citizens' committee has requested that a fence shall be constructed around the reservation, that trees shall be planted, and water introduced. The cost of the work requested will be $1,500, and an estimate for that amount is submitted.

If Congress deems it best to continue the privileges extended by the acts of August 30, 1890, and March 2, 1895, there should be some punishment prescribed for breaches of the rules and regulations governing the parks, and there should be regular watchmen on duty at all hours—not simply for eight hours of the day. The duty of these watchmen should be to prevent improper characters from interfering with the children and to see that all proper regulations are thoroughly enforced.

GROUNDS NORTH AND SOUTH OF THE EXECUTIVE MANSION.

These grounds include those within the iron fences north and south of the White House, together with the entire reservation known as the President's Park, south of the White House, Treasury Department, and State, War, and Navy building, north of B street and between Fifteeenth and Seventeenth streets.

Within the White House grounds, both north and south, the entire park has been maintained in excellent condition; lawns have been mown, flower beds planted with flowering bulbs and with summer and autumn flowering and foliage plants; trees and shrubs have been pruned, fountains repaired, and the fountain basins planted with water lilies for summer bloom.

In the north grounds the old rubble masonry wall upon which the iron fence is located has been carefully pointed with cement, and the wall, the fence thereon, together with the piers and gates at the entrances, have been thoroughly painted.

The uneven, worn, old flagging pavement leading from the Pennsylvania avenue entrances to the north balcony of the Executive Mansion has been removed and replaced with 931 square yards of granolithic pavement.

In the south grounds a strip of asphalt roadway, covering an area of 207 square yards, has been laid on the main thoroughfare immediately in front of the south balcony.

The northern portion of the grounds outside the iron fence fronting the State, War, and Navy building and the Treasury Department should be highly improved; the Treasury Department photograph gallery and greenhouses should be removed; bedding plants for use of the

Treasury Department could be provided at the propagating gardens if deemed necessary.

The White House stable should be moved from the grounds fronting the State Department, where it is manifestly out of place, and the park generally should receive such further improvement as is needed, by the construction of asphalt walks to replace the present gravel walks; additional walks for public travel through these grounds, increased water supply for irrigation, and increased drainage facilities are required.

The portion of the grounds south of the iron fence, covering an area of about 82 acres, and heretofore known as the President's Park, have been maintained in very good condition. During the year the main roads have been thoroughly repaired, raked, rolled, and watered during the summer season to keep down dust. Lawns have been mown, gutters repaired, drain traps cleaned, trees and shrubs pruned, dead trees and shrubs removed, walks edged, lawns sodded where necessary, and the entire reservation maintained in as excellent condition as was possible.

It has been frequently used for drills and parades by our citizen soldiers and by visiting military companies from other cities. Some years since a competitive drill lasting several days took place in the park, and recently the ground was occupied by the Grand Army of the Republic in their memorable reunion. On all of these occasions it has been apparent that a wide walk around the parade would be a desirable feature and afford safe standing room, out of the way of passing vehicles, for spectators, as well as a path for pedestrians visiting the locality.

With this object in view, it is suggested that an asphalt walk 15 feet wide be constructed around the outer portion of the ellipse, separating it from the carriage road by a parking 30 feet wide.

The American elm trees now bordering the parade would afford partial shade to this walk as well as to the roadway; at all the principal outlets of the park to surrounding streets, wide walk openings would be made to connect with these roads, and walk outlets for the convenience of the public.

It is estimated that the approximate cost of this walk, with its approaches, necessary drains, drain lodges, etc., will be $10,500.

During the spring and summer of 1895 the beauty of this park has been greatly marred by the construction of a large sewer running from Fifteenth street to Seventeenth street, which necessitated heavy excavation through the lawns and across the main roadway. In addition to the destruction of a section of the lawns it was necessary to remove from the line of the sewer 11 deciduous trees, 14 evergreens, and 149 shrubs, nearly all of which were destroyed; the sewer was constructed under the direction of the Commissioners of the District of Columbia in accordance with an act of Congress.

WASHINGTON MONUMENT GROUNDS.

This park, covering an area of about 78 acres, is the site of the Washington Monument. During the year every effort has been made to maintain the improved portion of the grounds in as good order as possible and to continue improvements so far as the limited funds available would permit.

Lawns have been frequently mown and an abundant supply of hay secured for use of the public animals belonging to the office. The main roads have been repaired, raked, and rolled, gutters and drain traps

cleaned and repaired, flower beds planted and watered, and a few dead trees removed. The old plank walks have been repaired, and 996 linear feet of new walks, 4 feet wide, have been laid on lines of pedestrian travel leading to the Monument and across the reservation.

The planting of the reservation has been continued, and 60 trees and 429 handsome shrubs have been set out during the year.

The section of this park between the main drive north of the Monument and B street north is now used for playing football and baseball, under the terms of the act of Congress approved August 30, 1895; for this reason, and also on account of lack of funds, no effort has been made during the year to improve this portion of the reservation.

It is again earnestly recommended that the electric-light system inaugurated in 1889 in the grounds south of the White House be extended throughout this park. There is now no method of artificial illumination between B street and the propagating gardens south of the Monument, between Fourteenth and Seventeenth streets, and in the interest of morality and for the protection of persons necessarily crossing these grounds at night, lights are necessary.

A complete detailed statement of the general plan of improvement projected for this great reservation was submitted in my annual report for the fiscal year ending June 30, 1893.

PROPAGATING GARDENS, INCLUDING THE GREENHOUSES AND NURSERY.

Extensive repairs were made to the various greenhouses and potting houses during the year and the large and valuable collection of plants was maintained in good condition.

A new rose house 130 feet long, 20 feet wide, and 12 feet high; a frame potting shed 20 feet long, 14 feet wide, and 11 feet high, and a new frame for small plants 130 feet long by 10 feet 6 inches wide and 7 feet deep were constructed during the year.

The necessary work in building these structures was done by the regular employees when they could be spared from their other duties, and the materials used, with the exception of one Hitchings fire-box hot water boiler and a portion of the glass, were nearly all old lumber, brick, iron pipe, etc., which had accumulated in past years at the storage grounds.

A large amount of shelving was placed in position during the winter and spring for use in the propagation of plants, and was taken down and stored during the early summer when the plants were placed in the parks.

Considerable miscellaneous work was accomplished in repairing cold frames, wooden shutters for protecting plants, constructing plant tubs, plant boxes, shades, etc.

About 380,000 bedding plants of about 240 varieties were propagated for spring planting in the public parks, and particular attention again given to chrysanthemums for autumn bloom.

In the autumn 13,200 plants, consisting of roses, smilax, carnations, heliotrope, bouvardia, stevia, geraniums, asparagus, candytuft, etc., and 19,000 bulbs, consisting of hyacinths, freesia, lilies, tulips, narcissus, and lilies of the valley were planted for winter and early spring bloom; about 53,000 bulbs were placed in the public parks for spring decoration.

The nursery grounds were maintained in good condition; lawns were mown, roads and walks repaired, gutters and drain traps cleaned, trees and shrubs pruned, and lily tanks repaired.

During the summer of 1894 300 tropical and subtropical plants and 525 ornamental trees were set out for stock.

In the autumn of 1894 the arbor vitæ hedge on the north and west fronts, which had lost its ornamental appearance, was removed and replaced with a hedge of California privet.

One hundred and eighty-two ornamental trees and 81 flowering shrubs were purchased and placed in the nursery grounds to become established before being placed in the parks.

A roadway 210 feet long by 10 feet wide was constructed, leading from the northwest entrance to the furnaces of the new rose house.

An additional gravel walk, 140 feet long and 5 feet wide, was constructed on the north side of Greenhouse No. 16.

Four hundred and four linear feet of flagging walk, varying from 1½ to 2 feet in width, was laid upon lines of pedestrian travel through the nurseries, and properly protected with cobblestone aprons at road crossings.

A new brick and cement tank 60 feet long, 15 feet wide, and 2½ feet deep was constructed for storing goldfish from the fountain basins during the winter and for planting water lilies for stock.

About 600 trees and shrubs were lifted and sent to various parks for ornamental purposes. In the spring about 6,000 plants and a number of bulbs were set out, and about 50,000 bulbs brought in from the parks were planted in order to ripen for next season.

Extensive improvements can well be made at these gardens. About 400,000 plants are annually propagated at the greenhouses for use in the summer and autumn decorations of the public parks; the beautiful water lilies and other aquatic plants used in many of the fountain basins are also propagated here.

The various structures are serviceable for the purposes for which they are used, and have been mainly erected by our own workmen at comparatively cheap cost; they are without ornamentation of any kind, and are maintained in repair by a small annual appropriation of $2,000. The buildings should be increased in number; a large palm house and a subtropical plant house are especially needed; greenhouse pits and cold frames are also required for the purpose of growing hardy herbaceous perennials, no plantings of which of any magnitude have as yet been made in any of the parks or other public gardens in Washington.

The nursery grounds of the gardens, exclusive of the ground occupied by the greenhouses, storehouses, sheds, roads, and walks, cover an area of about 4 acres, one-third of which is occupied by the greenhouse plantings for stock and hardy rose grounds; the remaining portion is thickly planted with young trees and hardy flowering shrubs, set out in rows ready for transplanting when required. This area is not sufficiently large to supply the tree and shrub plantings of the park extensions of the public grounds, and purchases are made of the varieties and character needed from commercial nurseries and wherever they can be found to supply deficiencies. It is hoped that in the near future, when the work of filling the Potomac flats near the propagating gardens is completed, the nursery grounds may be extended so as to furnish abundant room for the purposes for which they are intended.

I am frequently in receipt of requests for the loan of plants from the gardens for the use of churches, fairs, festivals, etc., and demands are constantly made for flowering and decorative plants for private purposes.

I am obliged to decline all such requests, as either the loan or gift of any plants would be in violation of the following extract from the act of Congress approved June 20, 1878:

Provided, That hereafter such trees, shrubs, and plants shall be propagated at the greenhouses and nursery as are suitable for planting in the public reservations, to which purpose only the productions of the greenhouses and nursery shall be applied.

After the annual spring planting in the parks is completed it sometimes happens that there is a small surplus of bedding plants on hand. These are divided among such public reservations or institutions as the State, War, and Navy building, Marine Barracks, Washington Aqueduct grounds, Fort Myer Military Reservation, various hospitals and orphan asylums. After these are supplied, should there still be a few such surplus plants remaining, they are given to whoever may ask for them.

SMITHSONIAN PARK GROUNDS.

This large reservation, located on the "Mall," nearly midway between the White House and the Capitol, and between the business sections of North and South Washington, is one of the most popular park resorts of the city. It contains within its boundaries the Smithsonian Institution, the National Museum, and the Army Medical Museum, all of which attract many visitors.

The area of the park is about 58 acres, the greater portion of which is laid out in lawn surfaces, about 9 acres being devoted to roads and walks.

During the year the improvements have been continued and the park maintained in good order. Gravel roads have been repaired, lawns mown and sodded where necessary, gutters and draintraps cleaned, trees and shrubs pruned, and a number of dead and unsightly trees removed.

About 305 square yards of asphalt roadway has been laid upon the gravel roadway northeast of the Museum building, and some minor repairs made to the asphalt roads constructed in former years.

Stake and wire fences were placed around flower beds to protect them from dogs.

In the autumn the flower beds were planted with 3,330 hyacinth, tulip, and crocus bulbs, which, after blooming in the spring, were replaced with summer decorative plants.

The watchman's lodge was thoroughly repaired.

The lawn surfaces of this park need renovation; they are planted with a great variety of deciduous and evergreen trees, many of them being the most perfect of their kind in the parks in this country.

It is earnestly hoped that the entire appropriation requested for this park may be granted. On account of the constant passage of teams—many of them heavily laden—over the gravel roads, it is difficult to maintain them in good condition during the winter and early spring. About eight years since the construction of asphalt pavements was commenced, and has continued from year to year, so far as available funds would admit, until now, out of an area of about 45,000 square yards of road and walk surfaces, over 15,000 square yards are of asphalt.

HENRY AND SEATON PARKS.

These two parks have an aggregate area of about 34 acres, mainly laid out in lawn surfaces, the planting of which has not as yet been completed; about 3 acres only are covered by gravel road and walk

surfaces. They extend from the Smithsonian grounds to the Botanic Gardens, which in their turn join the United States Capitol grounds, and complete the chain of parks extending from the Executive Mansion to the Capitol.

During the year the improvements have been continued and the park maintained in good order. Gravel roads have been repaired, lawns seeded and sodded where necessary, and mown from time to time, trees and shrubs pruned, and a few dead trees removed.

In Henry Park a new gravel walk 175 feet long and 10 feet wide was constructed, leading from the main drive to Sixth street.

The improvement of the large mound constructed some years since to screen the Baltimore and Potomac depot from the park was continued; 200 linear feet of the mound was graded, covered with soil and sown with grass seed, and 26 maple trees were planted; a stone flag pavement 1,860 feet long by 4 feet wide was laid on the south side of the main drive through these parks, between Third and Seventh streets.

A new floor was placed on the bridge across Sixth street by the Pennsylvania Railroad Company.

RESERVATIONS NORTH OF PENNSYLVANIA AVENUE AND WEST OF THE CAPITOL.

This division of the city embraces all the public reservations located between First and Twenty-eighth streets west and B street and Florida avenue north, the majority of which are in an advanced condition of improvement and require the constant attention of a force of skilled laborers employed for their proper maintenance.

It includes the highly improved parks known as Washington Circle, Rawlins Square, Du Pont Circle, Scott Circle, Lafayette Square, Franklin Square, Farragut Square, McPherson Square, Mount Vernon Square, Iowa Circle, Thomas Circle, Judiciary Square, and a number of other smaller but highly improved reservations.

During the year lawns have been properly mowed, seeded down or sodded where winterkilled, watered during the dry season, and their margins edged and trimmed; the gutters and drain lodges have been cleaned; trees and shrubs have been pruned and cultivated, and the young trees and shrubs and flower beds watered during the dry season; new trees and shrubs were planted, cocoons, webs, and caterpillars removed from trees and shrubs, and beds of ornamental foliage, flowering, and tropical plants set out; snow and ice removed from paths through and around the parks during the winter. This is a part of the regular annual work necessarily mentioned in the reports.

In Lafayette Square the lodge and closets attached thereto have been thoroughly repaired and improved. The group of evergreens on the site originally intended for the Lafayette statue has been remodeled by planting 95 ornamental evergreens and 6,000 hardy ivies; 6 handsome box trees, and 1 arbor vitæ have been placed in position near the lodge.

One hundred and ninety-three square yards of asphalt walks were repaired and resurfaced.

In Judiciary Square the lodge and the closets attached thereto were overhauled and repaired and the closets supplied with modern fixtures. The gravel roads were repaired and rolled, 216 cart loads of gravel having been used for this purpose. The lawn margin on Fifth street was lowered on the north and west sides of the Pension building, in order to conform to the grade of the new sidewalks laid by the District government.

The main driveway through the park on the line of F street was improved by laying 309 square yards of asphalt pavement. The road-

way leading from the Pension Office to the lodge was improved by constructing about 150 linear feet of cobblestone aprons, 2 feet wide, on each side of the asphalt walk crossing the road, in order to protect it from damage from heavy vehicles.

In Franklin Park 79 square yards of asphalt walks were resurfaced, the fountain basin repaired, and some dead or dying trees and shrubs removed.

The asphalt foot walks in the triangle containing the statue of General Rawlins were improved by resurfacing 105 square yards and laying 74 square yards of new pavement.

The asphalt walks through the two handsome little parks on Massachusetts avenue between Twelfth and Thirteenth streets were improved, 701 square yards having been repaired and resurfaced.

The mounds around the statue in Du Pont Circle, the Lafayette statue, and the Farragut statue were regraded and resodded.

The old maples which had served their purpose and were no longer ornamental were removed from the reservation at the southeast corner of Fourteenth street and Pennsylvania avenue, the entire park regraded, and grass seed planted, and a contract made for furnishing a granite curbing for the reservation. It is hoped to greatly improve this little park this season by laying curbing, constructing walks, and planting ornamental trees and shrubs.

In compliance with the request of the Attorney-General of the United States, the flower beds were planted in the Government lot at the corner of Pennsylvania avenue and Madison Place, and new shrubbery set out where necessary, for decorative purposes.

In the fall of 1894 20 flower beds were planted with handsome chrysanthemums for autumn bloom, and 21 beds were planted with 30,105 spring-flowering bulbs, consisting of hyacinths, tulips, crocuses, etc.

In the spring of 1895 132 flower beds were filled with flowering and foliage plants for summer decoration.

The excessive cold of the winter of 1894–95 did more or less damage to the trees and shrubs throughout the parks, particularly to the handsome magnolia trees.

Much work is still required in this beautiful section of the city. The parks should all be surrounded by granite curbings; all walks and roads should be of asphalt; the roads should have curbings and be properly drained. This is particularly true of Judiciary Park, which covers an area of about 20 acres, and the gravel roads of which are almost as much traveled as are the adjacent streets, and equally subject to wear from heavily loaded teams, rendering it very difficult to maintain them in good condition for travel during the winter. The first cost of asphalt roads and granite curbings would of course be approximately large, but the subsequent saving in the cost of their maintenance would in the course of a few years more than compensate for the original outlay.

In all the parks the lawn, tree, and shrub plantings should be well cared for and maintained in the highest degree of excellence. This will necessitate from time to time not only considerable trimming, but the removal of occasional trees and shrubs where too thickly planted, to secure future benefits not apparent to the casual observer.

RESERVATIONS EAST AND SOUTH OF THE CAPITOL.

This division of the city includes within its limits the highly improved reservations known as Lincoln, Garfield, Folger, Stanton, and Marion parks.

In all of these reservations, as well as in a number of smaller improved parks, the lawns were mown and seeded or sodded where winterkilled; all roads and paths were raked, repaired, and rolled, trees and shrubs pruned and watered, flower beds planted, and during the winter snow and ice removed from paths.

In Garfield Park the improvement of the drainage system was continued by laying 607 linear feet of cobblestone gutters, placing 41 feet of 4-inch iron pipe, and 105 feet of 6-inch terra-cotta pipe in trenches opened for that purpose, and constructing four brick sewer traps.

In Lincoln Park an asphalt walk, 5 feet wide, covering an area of 204 square yards, was laid from the Emancipation statue to the East Capitol street entrance, and all gravel walks were thoroughly repaired by using 422 cart loads of screened gravel.

Temporary board walks, covering a distance of about 500 linear feet, were laid in Stanton Square during the winter. It is expected to commence laying asphalt walks in this park during the season of 1895.

The fountains were repaired and put in good order in Lincoln, Stanton, and Folger parks, and water lilies planted in the fountain basins in Stanton and Folger squares.

Repairs were made to the plumbing in the lodge in Lincoln Park.

In the autumn of 1894 13 flower beds were planted with 19,142 spring-flowering bulbs, consisting of hyacinths, tulips, crocuses, and scillas, and in the late spring of 1895 44 flower beds were filled with flowering and foliage plants. The large vase in Marion Square was filled with tropical and flowering plants.

Minor improvements were made to a number of smaller reservations throughout this section of the city.

The final improvements projected for Garfield Park, covering an area of about 24 acres, are nearing completion. The main gravel road through this park leading to Virginia avenue is used as a thoroughfare for heavy teams, which renders it difficult to maintain it in good condition during the winter season.

It is regretted that the reduced appropriations will prevent the continuance of any extensive improvements, the amount available being not more than sufficient to maintain in good order the roads, walks, gutters, drains, lawn surfaces, trees, shrubs, and other improvements.

Stanton, Folger, and Marion parks are highly improved, planted with choice specimens of trees and shrubs, and laid out with gravel paths. There are fountains in Stanton and Folger parks, and Stanton Park contains the bronze equestrian statue of General Greene. The gravel walks in these reservations should be covered with asphalt.

In addition to these parks there are 28 small public spaces which have been partly improved and planted and about 100 similar spaces at the intersections of streets and avenues yet unimproved.

The increased prosperity of this section of our city and the large number of private improvements in progress demand that still more attention be given to beautifying the public spaces, and increased appropriations are earnestly recommended for this purpose.

SETTEES, TOOLS, MANURE, REPAIR OF POST-AND-CHAIN FENCES, AND REMOVING SNOW AND ICE.

There are 1,688 park settees available, of which 386 require repair, and the remainder are located in the various reservations throughout the city; 350 settees were repaired and painted during the season, and the remainder requiring repair will be put in order during the fiscal year 1895–96.

Repairs were made to lawn mowers, wheelbarrows, and miscellaneous tools, edge tools were sharpened and put in good order, and new tools purchased from time to time when necessary.

About 850 cubic yards of manure, 900 cubic yards of soil, 340 bushels of oyster-shell lime, and 253 cubic yards of potting sod were purchased.

About 2,000 cubic yards of compost was prepared and used in top-dressing the lawns of various parks, in mulching trees and shrubs, and in enriching flower beds; potting compost was also made for use in growing plants in the greenhouses.

Repairs were made to a number of post-and-chain fences, and 872 iron post caps which had been broken or stolen by vicious persons were replaced. A portion of the granite necessary for the curbing around the reservation at southeast corner of Pennsylvania avenue and Fourteenth street was purchased.

The snow and ice were removed as rapidly as possible from the paths and sidewalks through and around various reservations, and although the winter was one of unusual severity, we were enabled to accomplish the work in a comparatively satisfactory manner.

WATER PIPES AND FIRE PLUGS, AND CARE AND REPAIR OF FOUNTAINS IN THE PARKS.

Repairs have been made to the water pipes and valves from time to time when necessary. In the autumn water was shut off from the various parks and the hose valves removed and stored at the nursery grounds. In the spring these valves were replaced in the parks.

There are 22 fountains with basins in charge of this office, located as follows: Executive Mansion grounds, 3; Lincoln Square, 2; Stanton Square, 2; Rawlins Square, 2; and 1 each in Folger Square, Judiciary Square, Mount Vernon Square, Franklin Square, Iowa Circle, and the reservations at Massachusetts avenue and Twentieth street, New York avenue and Third street, Pennsylvania avenue and Nineteenth street, Pennsylvania avenue and Twenty-first street, Pennsylvania avenue and Twenty-eighth street, and Delaware avenue and First street NE.

With a few exceptions, the jets are of a very simple character.

There are 24 drinking fountains in the various parks. These were repaired where necessary, properly painted, and cups and chains renewed. The fountain basins were properly cleaned and thoroughly repaired before water was turned on in the spring. The large fountains in Mount Vernon Square, at the corner of Pennsylvania avenue and Ninth street, and at the corner of Pennsylvania avenue and Twenty-eighth street were scraped and painted.

In the autumn the water was turned off in the fountains, the jets removed and stored at the nursery shops. These jets were repaired where necessary during the winter and replaced upon the fountains in the spring.

PAINTING WATCHMEN'S LODGES, IRON FENCES, VASES, LAMPS, AND LAMP-POSTS.

There are 9 watchmen's lodges, 405 lamps, 18 vases, a large number of post-and-chain fences, the high iron fence around the Executive Mansion, and the iron fence around the greenhouses and nurseries under charge of this office.

For painting all of these the sum of $1,000 was appropriated for the present fiscal year. The result was that some necessary work was omitted.

It is earnestly recommended that the sum of $1,500 be appropriated for this work during the next fiscal year. During the past year the

following have been painted: The watchmen's lodges at Lafayette Square, Judiciary Square, and in the Executive Mansion grounds; the high iron fence, the gates and piers, and foundation walls thereof, on the north, south, and east sides of the Executive Mansion; the post-and-chain fences at Rawlins Square, Farragut Square, reservations near Scott Circle, Du Pont Circle, Mount Vernon Square, Judiciary Square, and 14 smaller reservations, covering in all about 1,300 posts with necessary chain; the vases, lamps, and posts within the Executive Mansion grounds and on the balconies; 125 lamps and lamp-posts, 20 drinking fountains, and 10 vases in various reservations.

The remainder of the lodges, lamp-posts, vases, and post-and-chain and high iron fences will be painted during the fiscal year 1895–96. This painting becomes necessary annually in order to assist in maintaining the beauty and neatness of the parks.

LIGHTING THE PUBLIC GROUNDS.

The grounds immediately south of the Executive Mansion are illuminated by electric lights, and it is earnestly hoped in the interest of morality as well as of good order that the system will eventually be extended to the Monument and Smithsonian grounds.

There are 403 ordinary gas lamps, with 456 burners, and 2 arc gas lamps belonging to this department. The arc lamps were discontinued during the year, they being rendered unnecessary by the brilliancy of the electric lights in the neighboring streets.

The number of lamps not connected with meters lighted during the year and paid for by this department was as follows:

July 1, 1894, to February 28, 1895	301
March 1, 1895, to June 30, 1895	317

Each of these lamps burned about 3,000 hours and consumed about 18,000 cubic feet of gas.

In addition to these there are 71 burners within the Executive Mansion grounds connected with the meters of the mansion.

It is earnestly recommended that the system of electric lights now in operation upon many of the streets and avenues of the city of Washington be gradually extended to the public grounds, especially to Lafayette, Franklin, and Monument parks. Estimates are submitted for the two former reservations, and the cost of placing the lights in position in the last would be $4,000.

Seventy new boulevard lanterns and 18 new lamp-posts have been purchased during the year and will be used in the more important parks in place of the old-fashioned lamps now in position.

TELEGRAPH CONNECTING THE CAPITOL WITH THE DEPARTMENTS AND GOVERNMENT PRINTING OFFICE.

The telegraph lines now under control of this office are as follows:

The line of overhead wires consists of 78 poles, covering a distance of about 3½ miles, with a length of about 8 miles of wire. This line, starting from the State, War, and Navy building, runs to the Executive Mansion, thence to the Treasury Department, thence to G street, thence to Eighth street, thence to H street, thence to North Capitol street, and thence to the Capitol. Connected with it is one running from the Treasury Department along Fourteenth street to the Bureau of Engraving and Printing, and one down Fifth street to the Pension building. There is about 500 feet of 13-conductor Patterson cable running from the cable pole in the Capitol Grounds into the basement of the Senate,

and 250 feet of 20-conductor cable running from the cable pole on the corner of Seventeenth and G streets into the State, War, and Navy building.

The underground cable laid by the Standard Underground Cable Company of Pittsburg in October, 1883, under permit granted for experimental purposes, and afterwards purchased by the Government in accordance with an act of Congress, has been useless for telegraphic operations since the winter of 1891–92, owing to the manner in which it was laid, being without any protection from the picks, etc., of workmen in the streets.

During the past year the main battery in this office and the local batteries and instruments in the various Departments have been maintained in good condition. Obstructions of all kinds were removed from the overhead lines as soon as possible and all breaks repaired. The entire line was carefully examined, 7 decayed poles replaced with new ones, new cross arms put up, and slack wire cut out

About 2 miles of old wire was removed and replaced with new No. 12 galvanized iron wire and No. 12 copper conductor weatherproof wire. This weatherproof wire was run through trees along the line, and was most useful during the past winter.

The instruments of the U. S. Senate and House of Representatives were placed in position at the opening of each session of Congress, and removed and stored away during the recess.

A telephone line was erected through the tunnel at the Washington Monument, connecting the boiler house, the engine room, and the elevator car.

Telephones were purchased for the United States lines connecting this office with the propagating gardens and the line belonging to the Executive Mansion.

Attention is again respectfully invited to the fact that it is becoming more and more difficult to operate the overhead telegraph system, owing to the growth of trees along the line, which interrupt the electric currents, especially during wet and windy weather.

The necessity for either replacing the present poles with taller ones or constructing a system of underground cable is so apparent that argument in its favor is unnecessary.

Estimates have been carefully prepared and submitted in previous years. The cost of the underground system will be $25,000, and the matter is presented for such action as Congress may deem best.

The poles of the present line are old, many of them badly decayed, some of them dangerous; the worst are annually replaced so far as funds will admit, but owing to the growth of the city trees higher poles are necessary in order to prevent the interruption of the electric currents during windy and stormy weather. An estimate of $1,600 is submitted for this improvement, and if the appropriation is made it must be coupled with authority to continue the line on the south side of G street, between Ninth and Eleventh streets NW.

At present the line crosses to the north side of G street at Eleventh street, and continues on that side for two squares; as the lines of the Western Union Telegraph Company are on the north side of the street it would be difficult to raise our lines above the trees without crossing to the south side.

The time has arrived when it is absolutely necessary either to construct an underground line or to use higher poles for the present line, if uninterrupted telegraphic communication is desired between the Capitol, the various Departments, and the Government Printing Office.

OLD RECORDS OF THE CITY OF WASHINGTON.

The time of the only draftsman allowed this office is mainly taken up with the care of the old records of the city of Washington, and his services are required in his office the greater portion of each day in order that he may exhibit them to those interested in city property. He is frequently summoned to produce the records in court.

These old records and maps show in detail the various transactions of the Commissioners, in connection with the original laying out of the city of Washington, the construction of the United States public buildings, and the sale of public lots between the years 1791 and 1867.

The first Commissioners were appointed by President Washington on January 22, 1791, in conformity with the terms of the act of Congress approved July 16, 1790, and the duties with which they were charged were transferred by various acts of Congress to their successors in office, who were appointed from time to time by the President of the United States.

By the act of Congress approved March 2, 1867, the office of Commissioner of Public Buildings and Grounds was abolished and the duties transferred to the Chief of Engineers, who thereby became the lawful successor of the original Commissioners appointed by President Washington in 1791, and the custodian of the original records.

Under date of March 13, 1867, Maj. Nathaniel Michler, Corps of Engineers, was assigned by the Chief of Engineers, under his direction, to the charge of the public buildings and grounds, and shortly afterwards received from the Secretary of the Interior and the late Commissioner of Public Buildings and Grounds what were believed to be all the books, records, archives, and papers pertaining to the office of the Commissioner and to the public works which had been under his charge.

These old records remained in the U. S. Capitol building from the time they were received by Major Michler in 1867 until February, 1884, during a portion of which time they were in charge of a messenger and open to examination by parties interested in them. I am informed that some of them were occasionally borrowed for official use by parties connected with the local government of the city of Washington.

In August, 1876, Mr. John Stewart, the earnest, faithful, and intelligent gentleman now in immediate charge of these records, under my direction, was assigned to their care, and since that date has devoted the greater portion of his time to their study and to briefing and indexing them.

In February, 1884, the records were brought from the U. S. Capitol to the office of the Chief of Engineers of the U. S. Army in the Winder Building, and in February, 1888, they were transferred to the State, War, and Navy building.

In the study of these old records Mr. Stewart has found a number of very important books and papers missing, and he has recently learned that many of these missing documents are now in the office of the city surveyor of the District of Columbia.

In April, 1890, my immediate predecessor, Col. O. H. Ernst, U. S. A., informed the Chief of Engineers as follows:

> It appears from the evidence of Mr. William Forsyth, surveyor of the District of Columbia, in case of United States *v.* M. F. Morris et al., that there are on file in his office certain original documents which would seem to properly belong here, such as the original plats of the city prepared under an order of the Commissioners in 1793, and the original notebook of James R. Dermott, containing soundings taken for the Dermott map.

Colonel Ernst requested that steps might be taken to secure the transfer to this office of all original books, maps, reports, or other documents which had at any time formed part of the records of the office and which were then in possession of the surveyor of the District.

Based upon Colonel Ernst's letter, the Secretary of War, under date of April 22, 1890, requested the Commissioners of the District of Columbia to take steps to cause the transfer to the War Department of the records in question.

The Commissioners called upon the surveyor of the District for information in the matter, and the latter, while acknowledging that there were a number of plats and papers in his office relating to the subject of surveys in the city of Washington, prepared by the early surveyors of the city, claimed that the surveyor of the District was the legal custodian of these papers and the District Commissioners declined to comply with the request of the Secretary of War.

It would seem eminently proper that these important and valuable archives should be retained by the Federal Government, as they contain among them original letters from Presidents Washington, John Adams, Jefferson, Monroe, Madison, and others, and cover the acts of the Presidents in connection with the United States public buildings and the United States reservations. It would also seem equally proper that all of these old records should be placed under the charge of one department of the Government, and I think Congressional action should be taken to decide under whose control they shall continue and to require that all records of the original Commissioners shall be turned over to the Chief of Engineers of the Army, who, by the terms of the act of March 2, 1867, became the legal successor of the first Commissioners.

As heretofore reported, Mr. Stewart, the draftsman who has had immediate charge of the old records for nearly a score of years, informs me that in his investigations he can find no satisfactory evidence to show that the United States has ever received payment or granted deeds in fee for a number of squares and lots in different parts of the city of Washington. By my direction he is now engaged in preparing a tabulated statement showing every lot originally belonging to the United States, as well as those which were sold by the General Government between the years 1791 and 1867.

I again invite attention to this important matter and urgently recommend that provision be made for the employment of a clerk to take charge of all the old records and make a complete and exhaustive investigation of the whole subject, and thus permit the only draftsman allowed this office to attend to his legitimate duties.

RESERVATIONS OCCUPIED, IT IS BELIEVED, IN VIOLATION OF LAW.

The following reservations claimed as the property of the United States are now occupied, it is believed, without authority of law:

Reservations Nos. 113, 127, and 197, by the Baltimore and Potomac Railroad Company.

Reservation No. 226, by the Baltimore and Ohio Railroad Company.

Reservation No. 125, by the Central Union Mission as a place of worship.

Reservation No. 186, by the Bethany Chapel of the New York Avenue Presbyterian congregation.

Reservation No. 293, intersection of Canal and N streets south and First street west, occupied by a party who built a frame house thereon in 1888; this case has been in the hands of the United States district attorney for the District of Columbia for the past six years.

Reservation No. 249 is occupied as a lumber yard by a party who claims to rent it from a gentleman in Port Deposit, Md.

Reservations Nos. 137, 138, 141, 152, 164, and 169 have been inclosed with iron or wire fences and partially improved by the owners of adjacent property.

STATUES.

There are 14 statues in the public grounds under charge of this office, as follows: Washington, Greene, Jackson, Lincoln (2), Scott, Farragut, Thomas, Du Pont, Rawlins, McPherson, Garfield, Henry, and Lafayette; all of these are in good condition, but there should be a small annual appropriation for pointing up the pedestals and cleaning the statues.

It is anticipated that within the next few years statues will be erected to the memory of Generals Sherman, Sheridan, Hancock, and Logan, and Prof. Samuel D. Gross, M. D., LL. D.

Estimates for the fiscal year ending June 30, 1897.

Salaries of employees, public buildings and grounds, etc.:		
One office clerk	$1,600.00	
One messenger	840.00	
One public gardener	2,000.00	
One clerk in charge of old public records of Washington City	1,500.00	
One electrician and telegraph lineman	1,080.00	
Overseers, draftsmen, copyist, foremen, gardeners, mechanics, and laborers	30,000.00	
One day watchman in Lafayette Park	660.00	
One day watchman in Franklin Park	660.00	
Two day watchmen in Smithsonian Grounds, at $660 each	1,320.00	
Two night watchmen in Smithsonian Grounds, at $720 each	1,440.00	
One day watchman in Judiciary Park	660.00	
One night watchman in Judiciary Park	720.00	
One day watchman at Lincoln Park and adjacent reservations	660.00	
One day watchman at Iowa Circle	660.00	
One day watchman at Thomas Circle and neighboring reservations	660.00	
One day watchman at Washington Circle and neighboring reservations	660.00	
One day watchman at Du Pont Circle and neighboring reservations	660.00	
One day watchman at McPherson and Farragut parks	660.00	
One day watchman at Stanton Park and neighboring reservations	660.00	
Two day watchmen at Henry (Armory) and Seaton parks, at $660 each	1,320.00	
One night watchman at Henry (Armory) and Seaton parks	720.00	
One day watchman at Mount Vernon Park and adjacent reservations	660.00	
One day watchman at grounds south of the Executive Mansion	660.00	
One watchman for greenhouses and nursery	660.00	
One day watchman at Garfield Park	660.00	
One night watchman at Garfield Park	720.00	
		$52,500.00
Contingent expenses, public buildings and grounds		500.00
Improvement and care of public grounds:		
Improvement and maintenance of grounds north and south of Executive Mansion	5,000.00	
Ordinary care of greenhouses and nursery	2,000.00	
Ordinary care of Lafayette Park	1,000.00	
Ordinary care of Franklin Park	1,000.00	
Improvement and ordinary care of Lincoln Park	2,000.00	
Care and improvement of Monument grounds	6,000.00	
Continuing improvement of Reservation No. 17 and site of old canal northwest of same	3,000.00	

Estimates for the fiscal year ending June 30, 1897—Continued.

Improvement and care of public grounds—Continued.		
Repair of post-and-chain fences, repair of high iron fences, and constructing stone coping about reservations	$1,500.00	
Manure and hauling same	5,000.00	
Painting watchmen's lodges, iron fences, vases, lamps, and lamp-posts	1,500.00	
Purchase and repair of seats	1,000.00	
Purchase and repair of tools	2,000.00	
Trees, tree and plant stakes, labels, lime, whitewashing, and stock for nursery	3,000.00	
Removing snow and ice	1,500.00	
Flowerpots, twine, baskets, wire, splints, moss, and lycopodium	1,000.00	
Care, construction, and repairs of fountains	1,500.00	
Abating nuisances	500.00	
Improvement, care, and maintenance of various reservations	15,000.00	
Improvement, maintenance, and care of Smithsonian grounds, etc	5,000.00	
Improvement, care, and maintenance of Judiciary Park	5,000.00	
Granite curbing about Franklin Park	5,000.00	
Laying asphalt walks in various reservations	2,000.00	
Improvement and care of Henry and Seaton parks	3,000.00	
Improvement of Howard University Park	5,000.00	
For lodges for park watchmen at Stanton, Mount Vernon, Iowa, Du Pont, Thomas, and McPherson parks, at $500 each	3,000.00	
Cleaning statues and repairing pedestals	100.00	
Improvement of Reservation No. 32, southeast corner Pennsylvania avenue and Fourteenth street NW	1,500.00	
Improvement of Hancock Place, corner Pennsylvania avenue and Seventh street NW	3,000.00	
Improvement of Reservation No. 19, near navy-yard	3,000.00	
Fencing and planting children's playground in East Washington (Reservation No. 126)	1,500.00	
		$90,600.00
Care, repairs, fuel, etc., Executive Mansion:		
For care, repair, and refurnishing Executive Mansion, to be expended by contract or otherwise, as the President may determine	20,000.00	
Fuel for Executive Mansion, greenhouses, and stable	3,000.00	
Care and necessary repair of greenhouses	5,000.00	
Repairs to conservatory	2,000.00	
		30,000.00
Lighting the Executive Mansion and the public grounds:		
Gas, pay of lamplighters, gas fitters, and laborers; purchase, erection and repair of lamps and lamp-posts, purchase of matches and repairs of all kinds, fuel and lights for office and office stable, for watchmen's lodges, and for greenhouses at the nursery: *Provided*, That for each 6-foot burner not connected with a meter in the lamps on the public grounds no more than $20.50 shall be paid per lamp for gas, including lighting, cleaning, and keeping the lamps in repair under any expenditure provided for in this act, and said lamps shall burn not less than 3,000 hours per annum, and authority is hereby given to substitute other illuminating material for the same or less price, and to use so much of the sum hereby appropriated as may be necessary for that purpose	15,000.00	
Electric lights for 365 nights from 7 posts, at 30 cents per light per night, $2.10 per night	766.50	
Lighting Lafayette Park with electric lights:		
For 1,305 feet of 5-inch terra cotta pipe, laid complete, with manholes, at 60 cents per foot	783.00	
For 6 iron poles complete in position, at $19.50 per pole	117.00	
Lighting Franklin Park with electric lights:		
For 1,442 feet of 5-inch terra cotta pipe, laid complete, with manholes, at 60 cents per foot	865.20	

Estimates for the fiscal year ending June 30, 1897—Continued.

Lighting the Executive Mansion and the public grounds—Continued.		
Lighting Franklin Park with electric lights—Continued.		
For 9 iron poles complete in position, at $19.50 per pole	$175.50	
For lighting for 365 nights 15 arc electric lights in Lafayette and Franklin parks, at 30 cents per light per night	1,642.50	
		$19,349.76
Repairs to water pipes and fire plugs:		
Repairing and extending water pipes, purchase of apparatus for cleaning them, purchase of hose, and for cleaning the springs and repairing and renewing the pipes of the same that supply the Capitol, the Executive Mansion, and the building for the State, War, and Navy Departments	2,500.00	
Telegraph to connect the Capitol with the Departments and the Government Printing Office:		
For replacing present poles with new and taller poles	$1,600.00	
For care and repair of existing lines	1,500.00	
		3,100.00
Total		198,549.70

Washington Monument, elevator, electric lights, and machinery connected therewith.

The following estimate for operating the elevator, the electric lights, and the machinery connected therewith for the fiscal year ending June 30, 1895, is submitted:

1 custodian, at $100 per month	$1,200
1 steam engineer, at $90 per month	1,080
1 assistant steam engineer, at $70 per month	840
1 fireman, at $60 per month	720
1 assistant fireman, at $60 per month	720
1 conductor of elevator car, at $75 per month	900
1 attendant on floor, at $60 per month	720
1 attendant on top floor, at $60 per month	720
3 night and day watchmen, at $60 per month each	2,160
For fuel, lights, oil, waste, packing, tools, matches, paints, brushes, brooms, lanterns, rope, nails, screws, lead, electric lights, heating apparatus, oil stoves for elevator car and upper and lower floors, repairs to engines, boilers, dynamo, elevator, and repairs of all kinds connected with the Monument and machinery, and purchase of all necessary articles for keeping the Monument, machinery, elevator, and electric-light plant in good order	3,000
Total	12,060

As some of the foregoing estimates are larger than the amounts heretofore appropriated, and as others are for new work, it is deemed advisable to submit the following brief explanation in reference thereto:

First. One public gardener, $2,000. I have asked for an increase in the salary of the public gardener, a position now so satisfactorily filled by Mr. George H. Brown. The duties of the office require that the gentleman who fills it shall be thoroughly skilled in the culture of trees, shrubs, and plants, and shall have a practical knowledge of civil engineering as applied to landscape gardening. Mr. Brown combines these attributes, to which he adds taste, industry, and integrity. His duties take him from one end of the city to the other. He is directly responsible for the care of the valuable collection of plants in the propagating gardens, and superintends the propagation of plants that are annually raised for the public grounds, which this year numbered about 400,000.

Second. One clerk in charge of old public records of Washington City, $1,500. These records include maps, deeds, record books, letters, etc., from the organization of the original Board of Commissioners, near the close of the last century up to 1867, when the duties were turned over to the Chief of Engineers. They are constantly examined by

attorneys and others interested in lands in Washington, and the person in charge of them is frequently required to produce them in courts. To index them properly, to be able to turn at once to the details of any question raised requires familiarity with every paper. This work has for the last few years been intrusted to the only draftsman allowed this office, and during the past year at least one-fourth of his time has been actually employed on this duty. It is desirable that this appropriation be made in order that the draftsman may be permitted to attend to the necessary and legitimate duties of his office.

Third. For one telegraph lineman, $1,080. The telegraph system under charge of this office includes about 8 miles of overhead wire. There are 18 offices connected with these lines, the main battery being at this office. The lineman is constantly engaged in the care of the main and local batteries and such necessary repairs and extensions as a system of wires of this kind requires. He is industrious, efficient, and capable, and has won the confidence of all with whom he has come in contact by faithful attention to his duties.

Fourth. An increase in the appropriation for overseers, foremen, etc., is suggested, as the city of Washington is spreading to the north, east, and west, the area of improved reservations must be increased to keep pace with private enterprise, and the small increase requested will be of the utmost advantage in continuing the ornamentation of spaces now entirely unimproved.

Fifth. An estimate is submitted for a day watchman at Garfield Park. The park is highly improved, covers an area of about 24 acres, and the necessity of a watchman for its care is apparent.

Sixth. For the care and improvement of the Monument grounds, $6,000. It is desirable that this important improvement should progress more rapidly than heretofore. The amount ($2,000) appropriated for 1895 was sufficient merely to maintain the park in its present condition and did not admit of any improvements in the unfinished portions of the grounds.

Seventh. For painting watchmen's lodges, iron fences, vases, lamps, and lamp-posts, $1,500 is requested. There are 8 watchmen's lodges, a number of post-and-chain fences, 18 vases, over 400 lamp-posts, and the iron fence around the Executive Mansion, all of which should be painted in 1896–97.

Eighth. For trees, tree and plant stakes, etc., and stock for nursery, $3,000 is asked, in place of the $2,000 last granted. The larger sum is the amount appropriated annually for more than twelve years ending June 30, 1892.

Ninth. For removing snow and ice the sum of $1,500 is asked. The sum usually granted, viz, $1,200, is generally sufficient, but sometimes is not.

Tenth. Fifteen thousand dollars is asked for improvement, care, and maintenance of various reservations, in place of the $10,000 granted this year. It is proposed to improve as many as possible of the unimproved reservations. Each year from one to five are added to the list of improved reservations, and if the funds now requested become available six or eight can be added during the fiscal year ending June 30, 1897. As reservations are thus improved the expense of the care of the whole is slightly increased, for the improvements must be maintained.

Eleventh. For the Smithsonian grounds $5,000 is asked, and for Judiciary Park $5,000, in place of $2,500 granted last year. The increased amounts can be profitably expended during the fiscal year ending June 30, 1897, in the improvement of those parks.

Twelfth. For placing granite curbing about Franklin Park $5,000 is asked. The beauty of this handsome park will be greatly enhanced by placing around it a granite curbing similar to those used around parks of the same style in the larger cities elsewhere.

Thirteenth. For laying asphalt walks in various reservations, $2,000 It is proposed to replace with first-class asphalt walks the gravel paths in Washington Circle, Mount Vernon Square, Stanton Square, Folger Square, Henry and Seaton parks, and to renew those in Farragut Square and Du Pont Circle. In the late fall, winter, and early spring these walks are muddy and pedestrians seek the lawns, which are thus destroyed by trespassers. The amount of these paths which it is proposed to lay is about 1,500 square yards. Each autumn it becomes necessary to put down plank walks, which must again be removed in the spring. If asphalt walks are laid the annual expense incident to plank walks will be avoided.

Fourteenth. For improvement, care, and maintenance of Henry (Armory) and Seaton parks, $3,000. These reservations, extending from Seventh street to the Botanic Gardens, cover an area of 34 acres, with road and walk surfaces of over 10,000 square yards. They are in an advanced state of improvement. Their beauty has been marred by the depot and tracks of the Baltimore and Potomac Railroad. A mound has been constructed around the depot, upon which it is intended to plant trees and shrubs, so that in time the depot will be hidden partially from view. The materials for this mound have thus far been obtained free of expense to the United States, and it is now proposed to complete the grading of the mound and to seed and plant it. The funds requested are needed for this purpose and for the care of roads, lawns, gutters, etc., and laying out additional paths.

Fifteenth. For lodges for park watchmen in Stanton, Mount Vernon, Iowa, Du Pont, Thomas, and McPherson reservations, at $500 each, $3,000. The watchmen in these reservations are exposed to the inclemency of the weather at all seasons of the year. Rain or shine, hot or cold, night or day, year in and out, they must be at their stations, and take shelter, when necessary, either under a tree or in such a dwelling or store as will offer its hospitality. The dictates of humanity call for this appropriation.

Sixteenth. The sum of $100 is asked for repairing pedestals and cleaning statues. Several of the pedestals need repointing, and the statues are from time to time disfigured by bird lime, which must be removed.

Seventeenth. Estimates are submitted for the improvement of the reservations at the corner of Pennsylvania avenue and Fourteenth street, $1,500, and Hancock Place, corner Pennsylvania avenue and Seventh street, $3,000. These are prominent places upon the principal avenue in the city, and it is urgently hoped that funds may be appropriated for their improvement and ornamentation.

Eighteenth. An estimate is submitted for the improvement of Reservation No. 19, near the navy-yard, as requested by certain citizens of Southeast Washington. Plans for beautifying this park, at an estimated cost of $12,000, have been prepared, and it is hoped that the necessary funds for the work will be appropriated.

Nineteenth. The appropriation requested for lighting the Executive Mansion and public grounds, and which is in excess of that made last year, is deemed very necessary in order to change the system in Lafayette and Franklin parks from gas to electric lights. In the interest of morality, as well as for the protection of persons visiting or passing through the parks after dark, it is desirable to make them as light as possible at night.

Twentieth. An estimate is again submitted for replacing the old and decayed telegraph poles with new and taller poles. The growth of the trees on the sidewalks renders it absolutely necessary, in order to maintain telegraphic communication over these wires, either to erect at once taller poles at a cost of about $1,600, or to lay an underground cable at a cost of $25,000. It appears to be the will of Congress that no more overhead wires shall be placed in this city. (See District of Columbia appropriation act of July 18, 1888.)

Twenty-first. I recommend that the salaries of the two steam engineers at the Washington Monument be increased from $80 and $60 to $90 and $70 per month, respectively. The duties of these two men are of great importance. Upon their efficiency and intelligence depend, to a great extent, the lives of those who use the elevator. The increase asked is small and the men deserve it. I also recommend that the pay of the two firemen be placed at $60 per month each. That is the rate allowed firemen in the Executive Departments and there appears to be no reason why the firemen at the Monument should receive less.

Twenty-second. An estimate of $1,500 is submitted for fencing, etc., children's playground, for reasons given in another part of this report.

In submitting these estimates I earnestly recommend that the various items under the heading of "Improvement and care of public grounds" be aggregated under one head, and while each item of work shall be named, the whole shall be covered by a general sum, not a specific sum for each item. This is done in other Departments of the Government, particularly the Quartermaster's Department of the Army. It saves quite an amount of clerical labor by permitting the preparation of accounts under one heading, rather than under about thirty; moreover, it permits small balances which might be saved from one item to be used in some other equally necessary and important work.

This recommendation is based strictly upon business principles and is for the purpose of reducing clerical labor and expediting the progress of the work.

Financial statement for fiscal year ending June 30, 1895.

Title of appropriation.	Year.	Available at beginning of fiscal year.	Expended during fiscal year.	Pledged by contracts.	Unexpended balance to revert to Treasury.
Improvement and care of public grounds	1895	*$48,700.00	$48,008.04	.....	$691.96
Repairs, fuel, etc., Executive Mansion	1895	35,500.00	29,661.14	.....	5,938.86
Lighting, etc., Executive Mansion, etc	1895	14,766.50	14,300.07	.....	466.43
Repairs to water pipes and fire plugs	1895	2,500.00	2,460.05	.....	39.95
Telegraph to connect the Capitol with the Departments and Government Printing Office	1895	1,250.00	1,249.30	.....	.70
Contingent expenses, public buildings and grounds under Chief of Engineers	1895	500.00	499.46	.....	.54
Salaries of employees, public buildings and grounds under Chief of Engineers	1895	47,060.00	46,997.44	.....	62.56
Care and maintenance of the Washington Monument	1895	12,170.00	12,014.92	.....	155.08
Portrait of Benjamin Harrison, ex-President of the United States	.....	2,500.00	.....	.....	.....
Ford's Theater building, repairs	.....	1,794.09	1,784.70	.....	9.39
Pedestal for statue of Gen. John A. Logan	.....	48,000.00	.....	$48,000.00	.....
Pedestal for statue of Gen. Winfield Scott Hancock	.....	47,000.00	.....	47,000.00	.....
Building for Government Printing Office, repairs and rent	.....	†65,000.00	27,951.25	6,477.00	.....
Building for Government Printing Office	.....	‡121,121.90	5,582.74	52,672.82	.....

*$500 appropriated by deficiency act approved March 2, 1895.
†Appropriated by sundry civil act, August 18, 1894.
‡Appropriated by sundry civil act, March 2, 1895.

In conclusion, I desire to express my sincere appreciation of the faithful and efficient manner in which Mr. George H. Brown, the skillful and accomplished public gardener, and Mr. E. F. Concklin, overseer and chief clerk, have performed the various and important duties committed to their charge.

I am, General, very respectfully, your obedient servant,

JOHN M. WILSON,
Colonel, Corps of Engineers, U. S. A.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

APPENDIX E E E.

NORTHERN AND NORTHWESTERN LAKES—SURVEYS—CORRECTING ENGRAVED PLATES—PRINTING AND ISSUING OF CHARTS.

REPORT OF COL. O. M. POE, CORPS OF ENGINEERS, BVT. BRIG. GEN., U. S. A., FOR THE FISCAL YEAR ENDING JUNE 30, 1895.

UNITED STATES ENGINEER OFFICE.
Detroit, Mich., July 13, 1895.

SIR: I have the honor to transmit herewith, in duplicate, my annual report on the "Issue of the published charts of the Northern and Northwestern Lakes, and surveys made for the purpose of keeping these charts up to date," for the fiscal year ending June 30, 1895. * * *

Very respectfully, your obedient servant,

O. M. POE,
Colonel, Corps of Engineers, Bvt. Brig. Gen., U. S. Army.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

E E E 1.

NORTHERN AND NORTHWESTERN LAKES—SURVEYS—CORRECTING ENGRAVED PLATES—PRINTING AND ISSUING OF CHARTS.

The sundry civil acts of August 18, 1894, and March 2, 1895, each appropriated the following amounts for the fiscal years ending June 30, 1895, and June 30, 1896:

Survey of Northern and Northwestern Lakes.—For printing and issuing charts for use of navigators and electrotyping plates for chart printing, two thousand dollars.

For surveys, additions to, and correcting engraved plates, to be available until expended, twenty-five thousand dollars.

Under the first item the issuing of charts has been done in Detroit, Mich., from this office, the rest of the work required being attended to by the office of the Chief of Engineers, in Washington. During the fiscal year nearly all charts have been sold at the uniform price of 20 cents each. A few special lithographic charts have been sold for 25 and

10 cents each, and some charts have been issued free of charge for the official use of Government agents applying for them.

The following table shows the extent of this business:

Issue of the charts of the Northern and Northwestern Lakes during the fiscal year ending June 30, 1895.

Description.	Number.	Total.
On hand July 1, 1894	146	
Received during the year	5,318	
		9,464
Issued to United States vessels, officials, etc	394	
Destroyed, worthless, not showing corrections to date	104	
Sold at 25 cents each	13	
Sold at 20 cents each	4,657	
Sold at 10 cents each	27	
		5,195
On hand July 1, 1895		4,269

The sum of $937.35 was turned into the Treasury from sale of charts.

Total number of charts distributed to July 1, 1894	199,330
Distributed, etc., during fiscal year	5,091
Total distributed to July 1, 1895	204,421

Under the second item of the above appropriations a number of charts have had corrections and additions made upon them in this office, and have been forwarded to Washington in order that the necessary changes might be made upon the engraved plates.

The following charts have been amended in this office:

	Scale.
River Ste. Marie, Nos. 1 and 2	1:40000
Lake Superior, No. 2	1:400000
Portage Lake and River	1:30000
Lake St. Clair	1:50000
Detroit River	1:40000
Lake Erie	1:400000
Lake Erie coast chart No. 7	1:80000

The information embodied in the above charts was derived from the best available sources of information. This work has been seriously impeded by lack of sufficient funds. The work is essential, however, if the charts are to be used for navigating the lakes.

The combined chart of Lake Superior, on a scale of 1:400000, has been completed, and is now being photolithographed on a scale of 1:500000.

Chart No. 3 of the new series of St. Marys River is in course of preparation. The data is entirely derived from the surveys made since 1893, in connection with resurvey of St. Marys River, and the improvement of the ship channel and Hay Lake Channel.

Mr. Edward Molitor has had charge of this work, and when not engaged on other work has devoted his whole time to it with his well-known intelligence and skill.

RESURVEY OF ST. MARYS RIVER.

The increase in the draft of vessels navigating the Great Lakes and their connecting waters has rendered the resurvey of certain localities necessary. A large number of artificial changes have been made in the channels and harbors, and data obtained fifty years ago in the narrow or rocky parts of the waterway is not sufficiently accurate for

a navigation twice the depth of that at the time these surveys were made.

In conformity with the general plan of resurveying certain localities, a resurvey of St. Marys River was commenced in May, 1892, at an estimated cost of $64,080. Work was suspended on June 30, 1892, on account of the exhaustion of funds available. Four thousand dollars was allotted for the fiscal year ending June 30, 1893, and $20,357.43 for the fiscal year ending June 30, 1894. Work was resumed in January, 1893, and has been continued to date.

On June 30, 1894, latitude, longitude, and azimuth had been determined at the Soo Observatory, the Soo base line had been measured and the triangulation carried from it to the primary line, Larke-Rankin Mountain, and to the secondary line, Iroquois-South Gros Cap, connecting with the tertiary triangulation connecting the Straits of Mackinac with the lake survey work at the east end of Lake Superior, and the whole system was planned. All the topography and about 13 square miles of hydrography for the reach between Little Rapids and White Fish Bay for chart No. 3, St. Marys River, new series, had been obtained. A line of precise levels had been run from Sault Ste. Marie to Waiska Bay.

OPERATIONS DURING THE FISCAL YEAR ENDING JUNE 30, 1895.

Astronomical work.—Only a few latitude and azimuth observations were made from the Soo Observatory for the purpose of obtaining data in regard to the movement of the pole. Observations for astronomical azimuth were made at Station Gargantua, and azimuth will be determined for several other stations.

Triangulation.—Angles were measured at 31 stations of the primary and secondary systems, and a tertiary connection made between the head and foot of Hay Lake and between the West Neebish and Sailors Encampment. All this work has been computed, thereby completing the Detour connection. Work is in progress on the connection with the Lake Superior triangulation.

Magnetic observations have been made in the vicinity of Sault Ste. Marie and near Stations Gargantua and Crisp. This work will be continued for most of the stations.

Topography.—About 100 square miles of topography were obtained during the year for chart No. 2 of the new series for St. Marys River. The survey covered Sugar Island, the American shore to Sailors Encampment, and most of Lake George and the old channel.

Hydrography.—This work has been carried on in connection with the operations of improving the ship channel between Chicago, Duluth, and Buffalo, and improving Hay Lake Channel, and is used to supply the data for new charts of St. Marys River. In all, 176 square miles were covered, at a cost for field work of $60.85 per square mile. Soundings were taken through the ice, except in open places, which are being sounded at odd times during the summer. The area covered includes all channels from Point Iroquois to Sweets Point, about 4 miles above Detour.

Office work.—The adjustment of one primary pentagon and of the Detour connection was made and the geodetic positions of the stations computed. The tertiary system was adjusted to the main system and the geodetic positions determined. The soundings were all platted and the record sheets of the survey prepared.

PROPOSED WORK.

All the field work for the new chart No. 3, St. Marys River, has been completed and the chart is now being drawn by Mr. Edward Molitor. on a scale of 1:30000 to be photolithographed on a scale of 1:40000 The larger part of the data for chart No. 2 has been obtained and the surveys for same will probably be completed this season. The greater part of the data for chart No. 1 will probably be obtained during the coming fiscal year. If the weather is at all favorable there will be no trouble in measuring the angles of the triangulation during the next fiscal year. If this is accomplished, preparations will be made for measuring the Batchewana and Mackinac bases. It would be very desirable to have some discharge observations of the river made in connection with the improvements now going on. Everything is now in good running order and the work is being pushed as rapidly as possible.

The resurvey of St. Marys River has been under the local charge of First Lieut. Charles S. Riché, Corps of Engineers, U. S. Army, assisted by Assistant Engineers E. E. Haskell, H. Von Schon, Glen E. Balch, and Thomas Russell. The hydrography was in charge of Assistant Engineer Joseph Ripley, assisted by Assistant Engineers Benno Rohnert, C. Y. Dixon, and Inspector Morrison. In Lieutenant Riché's report and the subreports attached thereto can be found all the details connected with the prosecution of the work.

ANNUAL WATER LEVELS OF THE NORTHERN AND NORTHWESTERN LAKES.

Daily observations were made under my direction at Sand Beach, Mich., on Lake Huron, and at the head of St. Marys Falls Canal, Sault Ste. Marie, Mich.

The following table embodies the results:

Monthly mean of water levels for the following-named stations below the planes of reference adopted in 1876.

Station.	1894.						1895.					
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Sand Beach	3.38	3.65	3.84	4.08	4.27	4.57	4.82	4.94	4.93	4.83	4.66	4.59
Sault Ste. Marie	2.178	2.169	2.301	2.259	2.358	2.659	2.959	3.095	3.296	3.317	2.915	2.527

ESTIMATE.

The resurvey of St. Marys River is now in progress, and the work is being pushed as rapidly as available funds will permit. The traffic through the river is already so great that the publication of new charts is becoming more and more essential every day. These charts would show to the navigator the new channels upon which the Government has been expending so much money, together with all ranges and landmarks along the shores. They would show the best courses for his vessel to run and the dangers to be avoided in the difficult navigation of this portion of one of the great commercial waterways of the world.

Throughout the Great Lakes region larger and larger vessels are being built each season. Their value to the general public is increasing

every year, and nothing should be left undone in efforts looking toward the safety of these costly vessels and their cargoes.

The connecting channels of the lakes are now from 4 to 5 feet deeper than they were when the original surveys were made, and a still further increase in depth of 4 feet is approaching completion. When the new 20 and 21 foot channel is finished the depth in many places will be more than double what it was originally. The increased draft of the vessels using these channels, combined with the low water of recent years, has caused the larger and more expensive vessels to discover dangers previously unsuspected and to discover them by the costly process of striking them. All dangers so discovered should at once be surveyed and located upon the charts in order to prevent the repetition of similar accidents at the same point. Localities deemed perfectly safe for navigation when smaller vessels were used are now regarded with suspicion by the larger vessels, and it is essential that certain special areas be reexamined.

Accurate knowledge of dangerous obstructions can be obtained in but one way, and that is from charts. When the Government sells charts to navigators, these charts should embody the latest and most accurate information concerning the localities to which they refer. It is essential, therefore, that all the charts be kept constantly up to date. The organized districts, in connection with the river and harbor work of the Corps of Engineers now established at the chief cities on the lakes, will greatly facilitate this work and will insure the maximum results with the minimum cost.

For the completion of work on St. Marys River and for the prosecution of the work necessary to obtain the requisite additional data for the proposed new chart of Whitefish Bay, $40,000 can be profitably and economically expended during the fiscal year ending June 30, 1897, excluding amounts for other surveys on the lakes. In addition, new charts of the river must be drawn, engraved, and printed. At the same time other localities must not be neglected. New shoals should be resurveyed as promptly as discovered. New light-houses, buoys, landmarks, channel improvements, etc., must be located and marked upon existing charts. This work is accumulating, and it increases the longer it is postponed. In view of all these facts, an estimate is submitted of $75,000 for "surveys and other expenses connected with the correcting and extending of charts of the Northern and Northwestern Lakes, to be available until expended," in full confidence that the conditions actually existing amply warrant this expenditure.

Estimate for the fiscal year ending June 30, 1897.

For printing and issuing charts for use of navigators and electrotyping plates for chart printing	$3,000
For surveys and other expenses connected with correcting and extending the charts, including resurvey of St. Marys River, to be available until expended	75,000
Total	78,000

Money statement.

SURVEY OF NORTHERN AND NORTHWESTERN LAKES.

Amount allotted from sundry civil act approved August 18, 1894		$21,000.00
Amount allotted from sundry civil act approved March 2, 1895		20,000.00
		41,000.00
June 30, 1895, amount expended during fiscal year		11,940.65
July 1, 1895, balance unexpended		29,059.35
July 1, 1895, outstanding liabilities	$3,377.65	
July 1, 1895, amount covered by uncompleted contracts	4,185.49	
		7,563.14
July 1, 1895, balance available		21,496.21
Amount (estimated) required for completion of existing project		75,000.00
Amount that can be profitably expended in fiscal year ending June 30, 1897		75,000.00
Submitted in compliance with requirements of sundry civil act of March 3, 1893.		

Dates and amounts of appropriations for survey of Northern and Northwestern Lakes.

March 3, 1841	$15,000	July 20, 1868	$75,000
May 18, 1842	20,000	March 3, 1869	100,000
March 1, 1843	30,000	July 15, 1870	100,000
June 17, 1844	20,000	March 3, 1871	175,000
March 3, 1845	20,000	June 10, 1872	175,000
August 8, 1846	25,000	March 3, 1873	175,000
August 12, 1848	25,000	June 23, 1874	175,000
March 3, 1849	10,000	March 3, 1875	150,000
September 28, 1850	25,000	July 31, 1876 (not including $16,000 applied to survey of Mississippi River)	84,000
March 3, 1851	25,000		
August 30, 1852	25,000	March 3, 1877 (not including $25,000 applied to survey of Mississippi River and including $9,500 received from sale of steamers)	94,500
March 3, 1853	50,000		
August 5, 1854	50,000		
March 3, 1855	50,000	June 20, 1878 (not including $49,500 applied to survey of Mississippi River)	49,500
August 30, 1856	50,000		
March 3, 1857	50,000	March 3, 1879	85,000
June 12, 1858	75,000	June 16, 1880	40,000
March 3, 1859	75,000	March 3, 1881	18,000
June 21, 1860	75,000	August 7, 1882	12,000
March 2, 1861	75,000	March 3, 1883	3,000
July 5, 1862	105,000		
February 9, 1863	106,879	Total	2,942,879
July 2, 1864	100,000		
February 28, 1865	125,000		
June 12, 1866	50,000		
March 2, 1867	77,500		
March 2, 1868	77,500		

PRINTING AND ISSUE OF CHARTS FOR USE OF NAVIGATORS AND ELECTROTYPING COPPER PLATES FOR CHART PRINTING.

March 3, 1883	$3,000	March 3, 1891	$2,000
July 7, 1884	3,000	August 5, 1892	2,000
March 3, 1885	3,000	March 3, 1893	2,000
August 4, 1886	2,000	August 18, 1894	2,000
March 3, 1887	2,000	March 2, 1895	2,000
October 2, 1888	2,000		
March 2, 1889	2,000	Total	29,000
August 30, 1890	2,000		

SURVEYS AND ADDITIONS TO AND CORRECTING ENGRAVED PLATES.

March 2, 1889	$5,000	August 18, 1894	$25,000
August 30, 1890	10,000	March 2, 1895	25,000
March 3, 1891	10,000		
August 5, 1892	5,000	Total	105,000
March 3, 1893	25,000		

Abstract of bids for supplies for survey of Northern and Northwestern Lakes, received and opened on April 22, 1895, in accordance with advertisement dated April 1, 1895.

No.	Name and address of bidder.	Supplies.	Total.
1	P. M. Church & Co., Sault Ste. Marie, Mich	Hardware, ship chandlery, etc	* $836.82
2	R. G. Ferguson, Sault Ste. Marie, Mich	do	879.17
3	Crystal Oil Refining Co., Cleveland, Ohio	do	† 102.50
1	J. B. Sweatt, Sault Ste. Marie, Mich	Lumber	* 120.00
2	Emery D. Weimer, Ludington, Mich	do	152.50
1	Prenzlauer Bros., Sault Ste. Marie, Mich	Groceries	* 1,577.94
2	P. C. Keliher, Sault Ste. Marie, Mich	do	1,661.00
3	Charles Supe, Sault Ste. Marie, Mich	do	1,672.24
4	——— ———, Sault Ste. Marie, Mich	do	‡ 1,970.55
1	Andrew Hotton, Sault Ste. Marie, Mich	Meats	* 1,220.00
2	Newton & McBain, Sault Ste. Marie, Mich	do	1,234.00
3	Donaldson & Hall, Sault Ste. Marie, Mich	do	1,270.00
1	Prenzlauer Bros., Sault Ste. Marie, Mich	Vegetables	* 257.56
2	Charles Supe, Sault Ste. Marie, Mich	do	287.19
3	——— ———, Sault Ste. Marie, Mich	do	‡ 386.65
1	The Richmond & Backus Co., Detroit, Mich	Stationery	* 399.11
2	J. L. Hudson, Detroit, Mich	do	420.43

* Recommended for acceptance.
† Incomplete; bid on oil on one copy only.
‡ Not signed; supposed to be N. C. Morgan & Co.'s bid.

List of contracts in force during the fiscal year ending June 30, 1895—Survey of Northern and Northwestern Lakes.

Name of contractor.	For—	Entered into—	Remarks.
The Richmond & Backus Co	Stationery	Apr. 27, 1893	Closed Dec., 1894.
P. M. Church & Co	Hardware, ship chandlery, etc	Aug. 25, 1894	Do.
Prenzlauer Bros	Groceries	do	Do.
Andrew Hotton	Meats	do	Do.
J. B. Sweatt	Lumber	do	Do.
The Richmond & Backus Co	Stationery	do	Do.
P. M. Church & Co	Hardware, ship chandlery, etc	May 10, 1895	In force.
J. B. Sweatt	Lumber	do	Do.
Prenzlauer Bros	Groceries	do	Do.
Andrew Hotton	Meats	do	Do.
Prenzlauer Bros	Vegetables	do	Do.
The Richmond & Backus Co	Stationery	do	Do.

REPORT OF LIEUT. CHARLES S. RICHÉ, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., July 4, 1894.

SIR: I have the honor to submit the following report of operations of the survey of the Northern and Northwestern Lakes, resurvey of St. Marys River, for the fiscal year ending June 30, 1895:

At the beginning of the fiscal year latitude, longitude, and azimuth had been determined at the "Soo" Observatory, the "Soo" base had been measured, and the triangulation had been carried from it to the primary line △ Larke to △ Rankin Mountain and to the secondary line △ Iroquois to △ South Gros Cap, connection being made at the latter line with the river improvement tertiary triangulation which extends along the river from Point Iroquois to Mud Lake. In addition, the entire primary connection between the old triangulation at the east end of Lake Superior and that at the Straits of Mackinac had practically been planned and a number of the necessary stations built. All of the topography and about 13 square miles of the hydrography for the reach covered by chart No. 3 of the new series had been obtained. A line of precise levels had been carried from Sault Ste. Marie to Waiska Bay. The platting of the work was in a very forward shape, and the computations of all the work that had been done were practically completed.

The allotment for the fiscal year was $18,000, subsequently increased to $21,000, but owing to delay in the passage of the sundry civil act this did not become available for use until after the middle of September, 1894, and in the meantime the survey organization was engaged in pushing toward completion the triangulation which controlled the St. Marys River improvements connected with the creation of a ship canal 20 and 21 feet deep between Chicago, Duluth, and Buffalo. A special allotment

of $15,000 for the resurvey of Hay Lake was also made from the appropriation for improving Hay Lake Channel; and this work, together with all the general hydrographic surveys of the St. Marys River connected with the improvement of the 20 and 21 foot ship channel, was assigned for execution to the lake survey organization. All duplication of work was therefore avoided.

With a view to giving a clearer idea of the operations of the survey, an account of all this work is given below, reference being made in the proper places when other work than that pertaining to the appropriation for the survey of the Northern and Northwestern Lakes is being described.

The results accomplished during the fiscal year are as follows:

ASTRONOMICAL WORK.

The only astronomical work done during the year at the Soo Observatory were a few latitude and azimuth observations made at various times by Assistant Engineer E. E. Haskell for the purpose of obtaining data in regard to the movement of the pole. This work has been much interrupted by cloudy weather and from the fact that it has so far been impossible to make azimuth observations at the observatory except during the winter months, as both the large theodolites are in the field during the summer season where they are used in measuring the angles of the triangulation. Observations for astronomical azimuth have been made by Assistant Engineer Haskell at △ Gargantua, and azimuth will be determined at several other primary stations as they are occupied during the progress of the work. Further description of the astronomical work done will be found in the report of Assistant Engineer E. E. Haskell, appended hereto, marked B.

DESCRIPTION OF TRIANGULATION.

The triangulation is now sufficiently far advanced to permit an intelligent description to be given with the aid of Pls. I and II:

Starting from the big primary pentagon Larke, Rankin Mountain, Laird, Salters Hill, Duke, the "northern connection" (Pl. I) proceeds from the side △ Larke to △ Rankin Mountain by a primary quadrilateral with △ Iroquois to △ Pennefather; thence by primary quadrilateral Iroquois, Pennefather, Havilland, Parisian; thence by primary quadrilateral Havilland, Parisian, Crisp, Mamainse; thence by primary triangle, Crisp, Mamainse, Gargantua, the line between the two stations last named being one of the old Lake Survey lines at the east end of Lake Superior. From the line △ Havilland to △ Parisian a pentagonal connection is made by means of △ North Sandy, △ East Base, and △ West Base with the primary Batchewana base, yet to be measured. From stations Parisian, North Sandy, and Mamainse a secondary quadrilateral locates △ Whitefish, and from stations Whitefish and Parisian another secondary quadrilateral locates stations Robbins and Salt Point. Intermediate "flag stations" for the control of hydrography and topography are located along the shores of Whitefish Bay by intersection from three or more of the main stations. The work of measuring the angles of the northern connection is now in progress.

Going back once more to the line △ Larke to △ Rankin Mountain of the big primary pentagon, a secondary connection (Pl. II) is made with the Soo base, measured in 1892. All the angles of this connection were measured during the previous fiscal year.

From the line △ Laird to △ Salters Hill of the same pentagon springs the secondary system known as the detour connection (Pls. I and II). This starts with the pentagon Salters Hill, Laird, 19 Hay Lake, 59 Neebish, Ross; thence by pentagon Salters Hill, Ross, Winter Point, Rocky Point, Pointe aux Frênes; thence by quadrilateral Salters Hill, Pointe aux Frênes, Raber, Fort St. Joe, and thence by pentagon Salters Hill, Fort St. Joe, Bacon, Drummond, Detour. From stations Bacon, Drummond, and Detour connection is made with the present Detour Light-House and thence with the old Detour Light-House which was included in the old triangulation of the Straits of Mackinac. From stations Detour and Drummond connection is also made with Spectacle Reef Light-House. These two light-houses will also be read in from some of the stations in the Mackinac connection. Sufficient "flag stations" to control hydrography and topography are located along the shore of the river by intersection from three or more of the main stations. The angles of the big pentagon and of the Detour connection were measured during the fiscal year, but the system will have to be extended far enough to the eastward to control the entire hydrography of Potogannissing Bay between Drummond and St. Joseph Islands.

The Mackinac connection will probably start from the side △ Duke to △ Salters Hill, of the big pentagon, and connect with the old Mackinac base by a series of primary quadrilaterals and pentagons as shown in Pl. I. Additional reconnoitering, however, may show that a more economical connection can be made from the primary line △ Duke to △ Iroquois. This reconnoitering will be done at once, and all

the stations of this connection will probably be erected early in the coming fiscal year, and the angles will be measured if the weather permits.

The river improvement tertiary triangulation (Pl. II) starts from the secondary line △ Iroquois to △ South Gros Cap, proceeds thence downstream to Little Rapids, where it branches, one branch going down the old channel via Lake George and Little Mud Lake to the secondary line △ Winter Point to △ Rocky Point, where it meets the other branch, which goes from Little Rapids down Hay Lake and the West Neebish. The two branches are also united by a small chain of triangles through the Middle Neebish, and at Round Island Light-House, △ 15, △ 14, △ 19 Hay Lake ⊡ 59 Neebish, and Lake George Light, the system is tied in by intersections from primary and secondary stations. This tertiary system has now been completed, having been executed from time to time from 1879 to date, as the necessities of the river improvement demanded.

PLANNING TRIANGULATION AND BUILDING STATIONS.

During the fiscal year prior to October 1, 1894, Assistant Engineer Glen E. Balch was engaged in building stations and planning that part of the Detour connection of the triangulation which served to connect the river improvement tertiary triangulation with the primary system, this work being done in connection with the "20 and 21 foot channel" improvement. After the appropriation for the survey of the Northern and Northwestern Lakes became available Mr. Balch planned and built the rest of the Detour connection, extending it as far south as Detour and as far east as Harbor Island, erecting enough tertiary or flag stations to control the hydrography and topography of the river from Mud Lake to Detour and Harbor Island. These tertiary stations were all to be located by intersection from three or more of the primary or secondary stations, and were not as a rule to be occupied by an instrument. The targets on these "intersection" stations, consisting of a peeled pole to which a flag was attached, have given them the name of "flag stations." The secondary system, as far south as Rocky Point, was planned last year by Assistant Engineer E. E. Haskell (see p. 3404, Report of the Chief of Engineers for 1894). Below Bocky Point the planning was done by Assistant Engineer Glen E. Balch, and all the stations of the system were erected by him.

Shortly before navigation opened for the season of 1895 Mr. Balch's party began the erection of the 100-foot station Crisp, completing it early in May. Since then this party has erected all of the remaining primary, secondary, and tertiary stations for the northern connection of the triangulation in and adjacent to Whitefish Bay, with exception of △ West base, the erection of this station being necessarily delayed until a sight line is cut along the proposed Batchewana base and the requisite height of the station can be determined. At the close of the fiscal year the cutting of this line was making good progress.

In all, during the fiscal year, Mr. Balch has erected 6 primary, 13 secondary, and 59 tertiary stations, and has placed targets on the greater number of them. For details concerning this work see Mr. Balch's report appended hereto, marked A.

Under the appropriation for the "20 and 21 foot channel," Assistant Engineer Joseph Ripley completed the planning of the tertiary triangulation of the river from Point Iroquois to Mud Lake and built the necessary additional stations, the work done during the fiscal year consisting of a connection between the triangulation at the head and that at the foot of Hay Lake, and a connection between the triangulation at the West Neebish and that at Sailors Encampment via the secondary line △ Winter Point to △ Rocky Point. In addition, a number of old stations that had disappeared were reestablished. Mr. Ripley's report is appended, marked F, and reference is made thereto for details.

MEASURING ANGLES.

Two parties have been engaged in measuring angles during the fiscal year. Until October 1 the work was confined to the connection between the river improvement tertiary triangulation and the primary system, being done in connection with the improvement of the "20 and 21 foot channel." Subsequently the triangulation was extended down the river, and all the angles of the Detour connection and of the big primary pentagon Larke, Rankin Mountain, Laird, Salters Hill, Duke, were measured by the close of the season of 1894.

At the opening of navigation in 1895 the two angle measuring parties again took the field, this time beginning work at the northern end of the "northern connection," the object being to dispose of the long lines of the triangulation there early in the season, when there was the greater probability of favorable weather, working down to the shorter lines as the weather became less favorable. It has proven impracticable even with the powerful telescopes attached to our two large theodolites to see targets, under the most favorable conditions, much over 20 miles away. Over long

lines, therefore, in place of targets it is necessary to use heliotropes, instruments which by means of a mirror reflect sunlight in the direction in which they are pointed. This, of course, restricts the measuring of angles between these long lines not only to such times as the atmosphere is clear, that is, when there is good "seeing," but also to times when the sun is shining. These favorable conditions occur for such a small percentage of the time as to cause this work to go very slowly.

In addition, with these long lines, there is always some good weather used up in getting the heliotropes correctly pointed. Every station to be read to must have a heliotrope placed upon it and properly centered, and men must be kept at these stations to flash sunlight in the proper directions. In the unsettled country along the shores of Lake Superior two, three, and even four men are needed at some of the stations for this purpose, and this, of course, greatly increases the cost of the work.

All things considered, therefore, I believe it to be the best practice to avoid using any lines longer than 20 miles whenever it be possible to do so. In the "northern connection," however, the length of the old line △ Gargantua to △ Mamainse, to which connection had to be made, has necessitated the use of some "heliotrope" lines, but the triangulation has been so planned as to make them as few as possible.

There was considerable uncertainty also in this work as to the possibility of seeing across the line △ Crisp to △ Gargantua under any conditions (see Pl. I). The two stations are over 60 miles apart. At △ Crisp the ground is 279 feet and at △ Gargantua 411 feet above the lake. On account of the curvature of the earth, a straight line connecting the two points would pass under the water for a considerable part of its length. From the top of an observing station 100 feet high at △ Crisp, a straight line to △ Gargantua would still pass under the water. Even with the ordinary refraction conditions of the atmosphere, which cause a bending in lines of sight and apparently "lift up" distant objects, the curvature of the earth was still sufficient to prevent the two stations from being intervisible. The only other way to connect with the old triangulation was by a series of stations a long distance back from the shore in the Canadian wilderness east of Lake Superior, where the cost of the work would have been almost prohibitory. It was known, however, that the refraction often becomes excessive, especially in the Lake Superior region, and a sufficient investigation of the subject was made (see pp. 3403, 3404 of the Annual Report of the Chief of Engineers for 1894) to warrant the belief that at times, especially in the spring, the refraction would become sufficiently great to apparently lift the two stations up and permit them to be seen from each other. It was determined, therefore, to build a station 100 feet high at △ Crisp, and, at the beginning of the season of 1895, to occupy both it and △ Gargantua, and wait a reasonable length of time for the good "seeing," the sunlight, and the excessive refraction, which were all needed to make this long line possible.

Our efforts were completely successful. By June 6 the line had been seen across sufficiently to measure all the angles depending upon it, and the angle-measuring parties were thereafter employed in other directions. The credit for the suggestion of this connection with the old triangulation belongs entirely to Assistant Engineer E. E. Haskell. The vertical angles at stations Crisp and Gargantua were both measured and the heights of the stations determined by lines of levels from the lake. This work will enable the coefficient of refraction to be computed for the atmospheric conditions under which the line was measured and will be of great assistance in planning future work of this character.

During the fiscal year the angle-measuring party under Assistant Engineer E. E. Haskell occupied the following stations: Larke, Rankin Mountain, Laird, Salters Hill, Duke, 19 Hay Lake, Detour, Burnt Point, Gargantua, and Mamainse. For details concerning the work reference is made to Mr. Haskell's report appended hereto, marked B.

During the fiscal year the angle-measuring party under Assistant Engineer Thomas Russell occupied the following stations: 19 Hay Lake, 59 Neebish, Ross, Winter Point, Rocky Point, Pointe aux Frênes, Raber, Fort St. Joe, Bacon, Drummond, 203, 208, 211, 218, 253, and Crisp. For details concerning the work reference is made to Mr. Russell's report appended hereto, marked C.

In addition, the following stations in the "Detour connection" were occupied by Assistant Engineer Glen E. Balch: Harbor Island, Detour Light-House, 217, 231, 253, and 277. (See appended report, A.)

The party under Assistant Engineer Joseph Ripley, in connection with the "20 and 21 foot channel" improvement, measured all the angles necessary to complete the river improvement tertiary triangulation and to reestablish some old stations that had disappeared. This involved the occupation for angle-measuring purposes of about 50 tertiary stations. (See Mr. Ripley's report appended, marked F.) This work having been done in connection with the supervision of dredging operations has involved practically no increased cost to the Government. An interesting description of the entire river improvement tertiary triangulation is given in Mr. Ripley's report. Attention is invited to the fact that the base lines of this triangulation were among the first to be measured with long steel tapes.

The work during the fiscal year has been much delayed by smoke, but in all 8 primary, 13 secondary, and about 60 tertiary stations have been occupied. The distinction between primary and secondary triangulation on this survey has so far been nominal. The secondary angles have been measured with the same care as the primaries. The distinction is made for convenience, in order to separate the main primary chain of triangles connecting Lake Superior with the Straits of Mackinac from the triangulation used to control the survey of the river.

The same method has been used to measure primary and secondary angles as was used during the preceding fiscal year, and reference to Mr. Haskell's and Mr. Russell's reports (B and C) will show that, with the high-grade instruments used, the results are as good, if not better, with five positions of the circle taken when conditions are favorable for seeing as when more positions of the circle are used and "seeing" conditions not so much regarded. The targets used in this work are certainly an important factor in the result. They are phaseless, and great care is taken in centering them. They are shown in Pl. III, and are fully described in Mr. Haskell's report, B. The "flag-station" target shown in the plate illustrates the type now in use on the stations in Whitefish Bay that are to be located by intersection. As they average from 10 to 20 miles in distance from the stations from which they are to be located, something better is needed than the flags on peeled poles which were used as targets for similar stations with the shorter lines of the Detour connection. As these stations are located without being occupied, no tripod need be used over them, and the target can be set directly over the station mark if desired. The tripods are a great convenience, however, for many purposes, particularly if the stations should have to be used during the winter, and as it costs very little to erect them when the target is being set, they have generally been put in. The pin wheel on top of the target is made of tin and sparkles when the sun is shining, the object being to permit the station to be "picked up" and identified by the observer, who would then read the angles to the target. Some of these pin wheels, however, have already sawed themselves off their supports, and it is doubtful if they will last long enough to be of much use.

The method of locating tertiary or "flag" stations by intersection without occupying them I believe, in general, to be a good one. Time is saved in the field, and, as a rule, a better location is obtained. In order to avoid excessive computations, however, the three stations from which any flag station is located should, with the flag station, form two well-proportioned adjacent triangles, as Mr. Haskell recommends, (B); and in most cases it would probably be more economical to occupy enough additional stations for this purpose than to make the extra computations.

During the progress of the angle measuring of the northern connection, Assistant Engineers Haskell and Russell will utilize the time, when conditions are unfavorable for triangulation, in surveying the shore line and in making hydrographic surveys of that portion of Whitefish Bay that is adjacent to the station they may be occupying at the time. It is hoped that enough of this work can be done to greatly reduce the additional field work necessary to permit the publication of the proposed new chart of Whitefish Bay—Mr. Haskell has already made a complete hydrographic survey of Gargantua Harbor—an excellent natural harbor of refuge on the east coast of Lake Superior; and Mr. Russell has obtained the topography adjacent to △ Crisp, together with the shore line for a couple of miles in the vicinity.

MAGNETIC OBSERVATIONS.

A theodolite-magnetometer and a dip circle having been obtained from the engineer depot at Willets Point, I observed for magnetic declination at two points in Sault Ste. Marie, rejecting one point on account of local attraction. Since then Mr. Haskell has observed for declination at Gargantua (see his report, B), and Mr. Russell at Crisp (see his report, C). Observations for declination will be made during the season in the vicinity of most of the stations occupied, and will be repeated at Sault Ste. Marie after the parties return from the field. Ultimately observations for magnetic intensity and dip will also be made.

TOPOGRAPHY.

But one party has been engaged in topographical work during the fiscal year. This party, however, is larger than either of the two parties previously employed, and has been organized differently. As a result, this work is progressing somewhat faster than with the two old parties, and it is costing less per square mile covered, although more detail is obtained, particularly along the shore of the river. A large proportion of the instrumental work is now done by the recorders, of whom during the season of 1894 there were two and during the season of 1895 three.

Assistant Engineer H. Von Schon is in charge of this work. His party began operations in September, 1894, as soon as the appropriation for the survey of the

Northern and Northwestern Lakes became available, and worked until October 1, when the party was directed to obtain the topography for the resurvey of Hay Lake, under a special allotment from the appropriation for improving Hay Lake Channel. This work was completed at the close of the season of 1894, and at the beginning of the season of 1895 the regular topographical work of the Lake Survey was resumed. By the close of the fiscal year 100¾ square miles had been surveyed, which, with the work done during the preceding fiscal year, completed the area shown on the progress map (Pl. I). Mr. Von Schon's report is appended, marked E, and reference is made thereto for details.

Attention is especially invited to the appendix to Mr. Von Schon's report, which gives such additional data concerning photosurveying or photogrammetry as Mr. Von Schon has been able to collect during the fiscal year. Mr. Von Schon has had a photogrammeter made at his own expense, and has made some practical tests of the method, which show very clearly that it can often be used to advantage.

Now that the topographical work is being done where use can be made of the completed triangulation, the plane tables are noticeably more used. At the same time the transit can not profitably be dispensed with; and although each instrument has its advantages and its disadvantages, they supplement each other to such an extent as to materially reduce the cost of the work from what it would be were either used alone.

To execute high-grade topography most economically a large instrumental outfit must be available, so that each particular character of country can be surveyed with the most suitable intrument. I believe that no topographical organization covering any considerable area should be without a photogrammeter in addition to the necessary plane tables, transits, levels, and reconnaissance instruments.

HYDROGRAPHY.

In connection with the improvement of the "20 and 21 foot channel," a hydrographic survey of the river was begun during the winter of 1893–94, and the results then accomplished are described on pages 2263, 2264 of the Report of the Chief of Engineers for 1894. Owing to poor ice and lack of sufficient time to procure additional ice-boring machines, only about 13 square miles of general hydrographic work was completed. For greater convenience in administration, the Lake Survey organization was charged with the further prosecution of this work, and early in the fiscal year five additional ice-boring machines were purchased, making a total of eight such machines available for use. These machines are similar in design to those described on pages 2963, 2964 of the Annual Report of the Chief of Engineers for 1893. Pl. V, submitted herewith, shows one of these machines in use.

Heretofore, for sounding through the ice, poles had generally been used up to a depth of 25 or 30 feet. For deeper water the ordinary lead line was used, being attached to a reel which was supported by a light sled. The lead line gives approximate results at best, its length is frequently changing, and its thickness causes it to be carried downstream an appreciable distance when there is any current. The sounding pole gives very accurate results, but its use is confined to comparatively shallow water, and it is difficult to handle. When using it, the leadsman becomes covered with water, and during freezing weather this renders the work very severe.

As the general hydrographic survey was to cover the entire river it was desirable to avoid changing sounding apparatus when passing from shallow to deep water and the reverse, and to get some contrivance which would answer for all depths likely to be encountered and which would be as accurate as the sounding pole.

Assistant Engineers Joseph Ripley and E. E. Haskell devoted considerable attention to this problem and finally devised a sounding reel which fulfilled all of the required conditions. Eight of these reels were constructed by Carpenter Edward Lambert, one of them being shown in Pl. VI. The reel consists of a wooden wheel with a brass plate and wooden guards extending around its circumference. This wheel is mounted on a sled and is turned by a crank; its circumference is made exactly 10 feet. Around the wheel extends sufficient length of No. 18 plow-steel wire, to which is attached a 7-pound lead. Feet and tenths, up to 10 feet, are marked on a dial on the side of the wheel around its rim. A friction indicator or pointer extends from the hub of the wheel to its circumference, and can be set at any given mark on the dial, retaining its position as the wheel is turned either to lower or raise the lead. In operation the reel is pushed to a hole that has just been made by the ice-boring machine, and the lead is lowered until its lower surface just touches the water. The friction indicator is then set at the proper position on one side or the other of the zero of the dial, to allow for the water-gauge reading at the time. The lead is then lowered rapidly to the bottom, full turns of the wheel are counted, and fractions of turns are read on the dial at the indicator. As proper allowance has already been made for the water-gauge reading, the soundings taken are automatically corrected to the plane of reference and require no further reduction

A number of tests of the reels have been made by comparing the soundings obtained by them with those obtained by sounding poles, and the readings of the two have been found to be practically the same. For deep soundings the reels give results far better than do the lead lines. Changes in length of the steel wire make no difference in the result as long as the circumference of the wheel remains 10 feet. The lead being heavy and the steel wire that carries it presenting but little surface to the water, no practical trouble has been experienced with currents. These reels undoubtedly afford the best and most rapid method of taking deep soundings, although for shallow water, 12 feet or less, short sounding poles can be used more rapidly. For the varying thicknesses of ice and depths of water met with in St. Marys River the reels and ice-boring machines are well matched. With thin ice and deep water the boring machines can make more rapid progress than the reels, while with thick ice and shallow water the reverse is the case.

The general plan of the survey was to divide the river into areas, each area having as its axis the sailing line generally used by vessels, or a line very close to it. Each area was then sounded along a series of cross sections at right angles to its axis and 500 feet apart. The soundings were taken on every cross section to 1,000 feet on either side of the axis, and on every alternate cross section the soundings were extended as close to the shore as the thickness of the ice would permit. Where the river was narrow every cross section was sounded to the shore, and where the water was less than 30 feet in depth intermediate cross sections were sounded. On each sounding line soundings were taken every 50 feet. A good idea of the plan of sounding can be had from Pl. IV, which shows the sounding lines, etc., for a characteristic portion of the river.

Before any area could be sounded it had to be staked out, sufficient stakes being driven on it to mark the various sounding lines. In order to locate these stakes correctly the angles which had to be turned off from the triangulation stations for each stake had to be computed in advance. The stakes were so placed as to be in lines parallel to the axis of the area and some even multiple of a thousand feet distant therefrom. The distance between any two stakes on the same sounding line was therefore an even multiple of the distance between soundings, and every stake thus served as a check for distance when soundings were being taken. At least three stakes were located on each sounding line, so that a range could always be had. After the stakes for a given area had been set by turning off the previously computed angles from the triangulation stations, a final check of the accuracy of the work could be obtained by seeing whether the stakes were ranged in straight lines parallel to the axis of the area and also along the various sounding lines at right angles thereto.

In addition to the general hydrographic system, critical portions of the sailing channel have been sounded very minutely from time to time for the proper control of dredging operations. As these localities were so well known no further special development of them was made except where necessary for the current estimates, etc., for river-improvement purposes.

The hydrographic work was in charge of Assistant Engineer Joseph Ripley. It was decided to put three parties in the field, and Assistant Engineers Benno Rohnert and C. Y. Dixon and Inspector L. P. Morrison were placed in immediate charge of these field parties. Mr. Ripley's report is appended hereto, marked F, and attention is invited for details to it and to the reports of Messrs. Rohnert, Dixon, and Morrison, attached thereto. The field parties aggregated about sixty men and were at work during the fiscal year for about two months and a half. During this time the hydrography of the river was obtained in all channels from Point Iroquois to Sweets Point, about 4 miles above Detour, except at a few places where the current prevented the ice from forming, and the hydrography necessary for the resurvey of Hay Lake was also obtained. In all, 176 square miles were covered at a cost per square mile for field work of $60.85, the computations costing an additional $3.82 per square mile and the platting $4.36 per square mile. One hundred and thirty-five thousand seven hundred and sixty-seven soundings were taken at a cost of about 6 cents per sounding. In addition, 39,813 soundings were taken for "estimate" surveys in connection with the contracts, etc., for deepening the channel. Great credit is due the chiefs of the field parties for the amount of work accomplished during the short period that the ice was in good condition.

Hydrographic surveys have been made during the winter for a good many years in connection with the improvement of St. Marys River, and opportunity has thus been offered to steadily improve the appliances used. Assistant Engineer Joseph Ripley has been associated with this work from the start, and is deserving of great credit for the improvements that have been adopted at various times. The method is now so precise that at any future time, provided a sufficient number of the triangulation stations could be recovered, the survey could be repeated and every one of the 135,000 soundings taken last winter could be relocated within a couple of feet. The opportunities thus offered for following changes in the river bed are apparent.

The hydrography taken through the ice is to the ordinary hydrography taken from boats as precision is to approximation.

The cost of the hydrography is not high when the character of the commerce through the river is considered. It might be possible to obtain the hydrography at less cost when navigation is open, in connection with the topographical work, by platting all buoys directly by means of the plane table, but the work could not be done so accurately nor could the soundings be so uniformly distributed.

In comparing this work with similar work executed during the season of navigation it must be borne in mind that stormy weather causes very little delay during the winter, while at other times it makes the water too rough to permit accurate sounding, and much time is lost on this account. In addition, the rectangular system of sounding lines used very greatly facilitates the platting. A "dummy" sheet can be prepared, ruled to scale in accordance with the sounding scheme in rectangles 50 by 500 feet. By fastening a piece of tracing cloth over this "dummy" the platting of the soundings becomes little more than the copying of them on the tracing from the notebooks. Two men platting can nearly keep abreast of the field work of sixty men, and three men platting could easily keep up. This is an important item, especially when accurate plats are wanted quickly.

Some of the places in the river where the ice did not form have since been surveyed from boats. Every care was taken, but the results, although the best that can be had, can not be compared with what could easily have been accomplished had ice formed over these places. The hydrography thus far obtained in this manner has been in the vicinity of Sault Ste. Marie, and was necessary in order that the entire reach covered by chart No. 3 of the adopted series could be completed.

OFFICE WORK.

In the office an adjustment of the big primary pentagon and of the Detour connection was made, and the geodetic positions of the various stations were computed. The river improvement tertiary triangulation was adjusted to the main system, and geodetic positions of all tertiary and flag stations were computed. The results of this work will be found in the tables submitted with the report of Assistant Engineer E. E. Haskell, appended hereto, marked B. The adjustment of the main triangulation was made in the same manner as last year (see p. 3327, Annual Report of the Chief of Engineers for 1894). Where five stations formed a pentagon with one line missing, however, a pentagonal adjustment was made, as the result was thought to be somewhat better, and the time required differed but little from what would have been needed to make an adjustment of the two overlapping quadrilaterals into which the pentagon could have been divided.

The method of adjusting the river improvement tertiary triangulation to the main system is described in the appended report of Assistant Engineer Thomas Russell, marked D, and attention is invited thereto for details.

The river improvement tertiary triangulation was all reduced, and coordinates of the stations were computed referring them to rectangular axes passing through △ 19, Sault Ste. Marie. One of these axes was the astronomical meridian at △ 19, the other of course being at right angles thereto. The flag stations from Mud Lake southward were also coordinated in a similar manner with reference to rectangular axes passing through △ Winter Point, the geodetic meridian being one of these axes. This work was done to facilitate the computations of azimuths from the triangulation stations to the various stakes to be driven in the ice for the hydrographic work. These rectangular coordinates are given in tables attached to the report of Assistant Engineer Joseph Ripley, appended, marked F, and in the same report will be found center-line equations and coordinates of certain of the stakes pertaining to the various ice areas, referred to the same axes, together with the elevation of the plane of reference of these areas above mean tide at New York. This information is sufficient to permit any of the soundings which have been taken to be relocated at any future time.

Considerable drafting was done in the office during the winter. This covered the platting of most of the soundings taken and the prepartation of the record sheets of the survey. These latter were entirely completed for the reach covered by chart No. 3 of the new series, and were duly submitted to enable the chart to be prepared for publication. A description of the drafting done will be found in the report of Assistant Engineer H. von Schon, appended, marked E.

PROPOSED WORK.

All field work for chart No. 3 has now been completed and mapped and the chart is in the hands of the draftsman. Considerable progress has been made on chart No. 2, and it is probable that all the field work for it will be completed by the close of the season of 1895. By the end of the fiscal year the greater part of the additional data needed for chart No. 1 will also probably be obtained.

If the weather should prove at all favorable, there would be no trouble in measuring all the angles of the triangulation during the next fiscal year. So far this season, however, there has been very little rain, and for the greater part of the time the atmosphere has been filled with smoke, often rendering it impossible to see over greater distances than 5 or 10 miles. It has only been possible, therefore, to measure angles during and just following a northwest wind. This wind, blowing from an unsettled region, is not laden with smoke as are the winds from other directions. This state of affairs is likely to continue until we have more or less rain. Every bit of good weather, however, will be used, and an effort will be made to use lights on the different stations so that the work can be prosecuted by night as well as by day when conditions are favorable.

Should the angle measuring be completed in time, work will probably be begun making preparations for the measurement of the Batchewana and Mackinac bases. It would be very desirable to have discharge observations of the river made, but this would probably be done best in connection with the improvement of the river. Everything is now in good running order and the work is being pushed as rapidly as possible.

CONTRACTS, EXPENDITURES, ETC.

The following contracts have been in force during the fiscal year:

List of contracts in force during fiscal year ending June 30, 1895—Survey of Northern and Northwestern Lakes, 1895.

Name of contractor.	For—	Entered into—	Remarks.
Andrew Hotton	Meats and ice	Aug. 25, 1894	Closed Dec., 1894.
Prenzlauer Bros	Groceries	do	Closed Jan., 1895.
P. M. Church & Co	Hardware and ship chandlery	do	Closed Mar., 1895.
J. B. Sweatt	Lumber	do	Closed.
The Richmond & Backus Co	Stationery	May 10, 1895	In force.
J. B. Sweatt	Lumber	do	Do.
Andrew Hotton	Meats	do	Do.
Prenzlauer Bros	Vegetables	do	Do.
Do	Groceries	do	Do.
P. M. Church & Co	Hardware and ship chandlery	do	Do.

The following statement shows, approximately, the expenditures during the fiscal year and the work to which they pertain:

Allotment	$21,000.00
Expenditures (estimated):	
Astronomical work	34.50
Planning triangulation and building stations	3,300.00
Measuring angles	5,200.00
Topography	3,300.00
Office work	3,000.00
Contingencies, etc	500.00
Total	15,334.50

GENERAL SURVEYS OF 20 AND 21 FOOT CHANNEL.

The following statement shows, approximately, the expenditures:

Planning triangulation and building stations	$850.31
Measuring angles	2,353.31
Hydrography	12,863.57
Office work	971.29
Contingencies, etc	3,076.67
Total	20,115.15

RESURVEY OF HAY LAKE.

The following contract has been in force during the fiscal year:

Name of contractor.	For—	Entered into—	Remarks.
J. B. Sweatt	Constructing quarters boat	May 6, 1895	In force.

The following statement shows, approximately, the expenditures:

Topography	$1,451.64
Hydrography	1,895.52
Office work	2,212.01
Contingencies, etc	558.60
Total	6,117.77

ESTIMATE.

For the completion of work on the resurvey of St. Marys River and for the prosecution of the work necessary to obtain the requisite additional data for the proposed new chart of Whitefish Bay $40,000 can be profitably expended during the fiscal year ending June 30, 1897. This does not include the amounts needed for survey purposes elsewhere on the lakes. It would be advisable for the amount appropriated to be available until expended, as is the case with the present appropriation, as this would prevent the work from having to stop in the best part of the season, as was often the case formerly, and would permit the survey to be conducted in the most economical manner.

The work already done has shown that very considerable natural and artificial changes have taken place in St. Marys River and its shores during the forty and more years that have elapsed since the original survey was made. The charts based on this original survey have become inadequate for the present commerce of the river. The ships using this great waterway have increased in number, size, and draft. Where 100,000 tons of freight passed through the river in 1855, over 13,000,000 tons passed in 1894, and the improvements now nearly completed will soon permit a draft of 20 feet to be carried between Lakes Huron and Superior. With a commerce of such magnitude, St. Marys River and Whitefish Bay should be surveyed with the greatest accuracy and detail, and no reconnaissance nor compilation of information of uncertain accuracy should be resorted to. The amount of the estimate ($40,000) is small in comparison to the advantages which would result by the early publication of new charts showing the channels to be run and the dangers to be avoided in the difficult navigation of this portion of the greatest commercial waterway of the world.

In conclusion, I desire to express my appreciation of the services rendered by all employed on the survey during the fiscal year, and particularly by Messrs. Ripley, Haskell, Russell, Von Schon, Rohnert, Dixon, Balch, and Morrison, who have been in charge of the various portions of the work. Once more, I must express my appreciation of the many courtesies received from the engineers and others employed upon river and harbor works in this vicinity, and must again acknowledge my indebtedness to Assistant Engineer E. S. Wheeler for valuable suggestions and advice.

Very respectfully, your obedient servant,

CHARLES S. RICHÉ,
First Lieut., Corps of Engineers, U. S. A.

Col. O. M. POE,
Corps of Engineers, U. S. A.

A.—REPORT OF MR. GLEN E. BALCH, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., June 30, 1895.

SIR: I have the honor to submit the following report of my work for the fiscal year ending June 30, 1895:

At the beginning of the year I was in the field with a construction party building the 48-foot station, Pennefather, and the 30-foot station, Laird, Ontario.

Upon finishing these stations my party was disbanded and I was employed at general office work until August 21, when a small tug, the *Antelope*, with accommodations for a crew of six men, was assigned to me with instructions to proceed on the building of the stations already located on the secondary system, extending from Station 19, Hay Lake, down to head of Mud Lake, and to locate and build whatever other stations might be needed to make a quadrilateral system which would connect Detour Light with the primary system. Also to locate and build flag stations for a tertiary system over this same area, which might be read in from three or more of the secondary or primary stations.

This work I completed between August 21 and November 13, locating and building 12 secondary stations and 44 tertiary stations. During this time our tug moved the topographical party twice and one of the observing parties four times; also carried

supplies from Sault Ste. Marie, Mich., to one or more of the parties weekly, taking two and sometimes three days out of every week for this work.

At nearly all of these stations the geodetic point is a hole one-half inch in diameter, drilled in a stone with the letters "U. S." cut near it. A secondary station in most cases had the usual cut stone 2 feet long and 6 inches square at the top, increasing somewhat in size at the bottom.

These are set in the ground with the top from 1 to 2 feet below the surface, depending upon the nature of the soil, and a post set over them with nail in top for surface mark. In a few places the geodetic mark was cut in a large bowlder, as at Ross and Rocky Point, or as at Station Drummond in the solid rock.

The tertiary or intersection stations are designated by numbers, beginning with No. 200 at the one on Two Tree Island, near head of Mud Lake, and from there numbering downstream, using the odd numbers on the Michigan side and the even ones on the Canadian side.

The number of the station was cut in the tripod and also on the stone containing the geodetic mark. The stones at these stations were flat-top field stones picked up along the shore.

The tripods at the tertiary stations were generally 6 feet high, set with top 4 feet above ground. Flags on peeled poles were put up over these tripods, and as some of the stations from which they were read to were very distant, making it difficult for the observer to determine what station he was observing, a system of black and white flags was used, enabling the observer to tell the station from the color of the flag.

A few of the tertiary stations were visible from only two of the occupied stations, so that it was considered necessary to occupy such stations, and thus obtain the third angle of the triangle.

There being some doubt as to whether the observing parties could finish the angle reading before the season closed, I was furnished with a Buff & Berger transit reading to 10 seconds and instructed to occupy some of the smaller stations, keeping the tug *Antelope* for the purpose.

I occupied Station Harbor Island, four of the tertiary stations, and Detour Light-House, making the connection between the new tower and the center (as near as I could determine it from the foundation) of the old tower.

On November 21 I returned to Sault Ste. Marie with tug *Antelope*, which was then turned over to Assistant Engineer H. von Schon.

The cost of my work from July 1, 1894, to November 21, 1894, has been as follows:

Planning triangulation and building stations under appropriations for 20 and 21 foot channel	$835.99
Planning triangulation and building stations under appropriations for survey of Northern and Northwestern Lakes	776.52
Reading angles under appropriation for survey of Northern and Northwestern Lakes	92.27
Total	1,704.78

From November 21, 1894, till April 5, 1895, I was in the office at Sault Ste. Marie, Mich., engaged upon the following work:

Making a plat of the entire chain of triangulation, including primary, secondary, and tertiary systems, from the line Iroquois–Pennefather down to Detour, upon one sheet to a scale of 1:60,000.

Assisting in the computations of the adjustment of the season's triangulation and the computing of the geographical positions of the primary and secondary stations, the result of which is given in Table No. 2 of the report of Assistant Engineer E. E. Haskell.

Computing geographical positions of the stations in the tertiary systems in West Neebish and Mud Lake and those in Lake George and East Neebish, located or relocated during 1894. The results of these are given in Table No. 4 of the report of Assistant Engineer E. E. Haskell.

Computing geographical positions of the lights between Sailors Encampment and Detour, and the intersection stations down to No. 213, the results of which are given in the report of Assistant Engineer E. E. Haskell, Table No. 6.

I began field work in April with a party building a 112-foot station at Crisp Point, Mich. Upon finishing this station we began on the Whitefish Bay work, the tug *Arthur* being turned over to us for this work, May 14.

The plan followed in this work was to leave all but a boat's crew of my men with a camp outfit to build one of the larger stations, while with the rest of the men and the tug I did the locating and the building of the tertiary or intersection stations, returning occasionally to inspect the work and move the party to another of the larger stations.

In this way the party on shore put up four primary stations and one secondary, while the tug put in 15 intersection stations, repaired some of the stations put up in 1893, moved the shore party four times, carried a heliotrope party to Station Havilland, and carried supplies to both of these parties from Sault Ste. Marie.

Whenever I could do so I found the stations of the survey of 1867 and 1868 and put our stations over the same points. All the data I had for finding the old stations was chart No. 1 of Lake Superior and a list of the stations with their latitudes and longitudes.

I succeeded in finding the exact geodetic points of stations Foott, Goulais Point, North Sandy, and Taquamenon Island, where stones were set. At Goulais River, South Sandy, and a point on the south shore of Batchewana Bay I found old posts with a hole in top of each, at Rudder Head, an old stump with the remains of a platform around it, at North Parisian, the remains of a large station and the location of the tripod feet, consisting of three piles of stone in the form of a triangle with 14-foot sides, and at South Parisian, although the remains of the old timbers were found, I could not locate the center with any certainty.

My party is at present on Batchewana Island engaged in clearing a line between a 35-foot station on the east end and a station on the west end, between which it is intended to measure a base line. The line is over comparatively low ground, with a few small rises of from 10 to 40 feet and some swamps which at this season of the year are very wet. It is about 5 miles between the stations and very thickly timbered. The tug *Arthur* was used for one week in setting targets, making the entire round of Whitefish Bay, placing targets on 25 stations.

The following is a description of the more important stations built during the past year:

Station Pennefather, on a hill in the township of Pennefather, about 500 feet west of the Goulais Bay road, and about 13 miles from Sault Ste. Marie, Ontario. The station is built of round timber and is 48 feet high. The geodetic point is a half-inch hole in the top of a cut stone 6 inches by 6 inches by 2 feet, set 2.14 feet below surface. Reference marks are crosses in neighboring bowlders, with letters "U. S." cut near crosses. The first is north $42\frac{3}{4}^\circ$ west, 49.61 feet; the second, south $27\frac{1}{4}^\circ$ west, 33.70 feet; the third, south $52\frac{3}{4}^\circ$ east, 26.52 feet.

Station Laird is in the township of Laird, Ontario, about 3 miles east of Lake George and 8 miles north of Port Finley. The station is on a hill of solid rock about one-half mile east of the road between Port Finley and Echo Bay, and one-half mile south of the house owned by a Mr. Rilley. The station is 30 feet high, and has for a geodetic point a cross cut in the solid rock.

Station 19, Hay Lake, is one of the Hay Lake tertiary stations. It is on the west shore of Hay Lake, and is in line with the point in Sugar Island opposite the upper end of the dike in Middle Neebish and the point on Neebish Island opposite the lower end of the dike.

Station 59, Neebish, is identical with Buoy Station 59 of the tertiary system. It is on the east side of the largest of the islands in the upper end of Little Mud Lake, and is about 4 feet east of the front range target for the course from the East Neebish Channel into Little Mud Lake. The station is 12 feet high. Geodetic point is a half-inch hole in a stone set about 15 inches below surface.

Station Ross is on the hill back of Ross Hotel on St. Joseph Island. The station is built over a large bowlder in which are cut the letters "U. S." and a half-inch hole for a geodetic mark.

Station Winter Point is on the extreme point of land which forms the northern limit between Mud Lake and Munuskong Bay, and is a few hundred feet southwest of the light-keeper's house. The station has an 8-foot tripod with target platform above it. The usual cut stone is set with top 1 foot below surface.

Station Rocky Point is on the point that forms the southern limit of Munuskong Bay. The station is within 20 feet of the beach and has a 6-foot tripod set over a bowlder in which is cut the geodetic mark (a half-inch hole) and the letters "U. S."

Station Point aux Frênes is on the cleared point on the Michigan side of the lower end of Mud Lake and across a small bay from an old sawmill. The station is about 15 feet from shore and about 300 feet north of the end of the point. The station is 26 feet high with the usual cut stone set 1 foot below surface.

Station Raber is that on the extreme end of a long narrow point about 2 miles below Raber Sawmill. The station consists of a 6-foot tripod with target platform above it. The usual cut stone is set 6 inches below surface.

Station Fort St. Joe is in the west end of one of the walls of old Fort St. Joseph, on the southwest end of St. Joseph Island. The station is 18 feet high with the usual cut stone set about 1 foot below surface.

Station Bacon is on an island in Potagannissing Bay that is known as Bacon Island or Island No. 10. The station is 24 feet high and is on the north end of the island. The usual cut stone is set 6 inches below surface.

Station Detour is on the top of a hill about 1 mile west of Pickands, Mather & Co.'s dock at Detour, Mich., and is about 800 feet south of the east and west road.

The station has a tripod 38 feet high with a target platform above. The usual cut stone is set 22 inches below surface.

Station Drummond is on the flat top of a limestone ridge on west side of Drummond Island, about a quarter of a mile from shore and nearly opposite Detour. The station is 21 feet high and has for a geodetic mark a half-inch hole drilled in rock about 15 feet from the edge of the ledge, with letters "U. S." cut near it.

Station Burnt Point, or No. 220, is on the east side of a small hill on Whisky Point, on south side of St. Joseph Island and west of Worlesley Bay. The station is 20 feet high and is on the side hill 300 or 400 feet from shore, at a point from which stations Detour, Drummond, and Bacon are visible. Geodetic point is a half-inch hole in a flat field stone, with letters "U. S." and No. 220 cut on it, set about 2 feet below surface.

Station Harbor Island is on a hill on the west horn of Harbor Island, about half a mile north of Mr. Church's house. The station is 29 feet high and the geodetic point is a half-inch hole in the top of a flat field stone, with letters "U. S." and No. 281 cut on it, and set about 18 inches below surface.

Station Crisp is on a hill in about the center of sec. 13, T. 50 N., R. 8 W., of Luce County, Mich., about 3 miles from life-saving station No. 10. The station is 112 feet high, the geodetic point being the usual cut stone.

Station Havilland is on the top of the highest hill between Goulais Bay and Batchewana Bay. It is about 2 miles north of Goulais Bay and about 4 miles south of Batchewana Bay. The station has a tripod 22 feet high with heliotrope platform above it, and is set on the solid rock. The geodetic point is a hole drilled in the solid rock with the letters "U. S." cut near it.

Station North Sandy (1895) is on the south end of North Sandy Island, on the ridge near the edge of the timber. The station is 28 feet high and has the usual cut stone set 2 feet below surface.

Station North Sandy (1868) is on the top of a bluff on west edge of same island. The old stone, with top 6 inches square and the letters "U. S." and a lead center, was found 12 inches below surface. A 14-foot station was built over this stone.

Station Robbins is 20 feet from the edge of the bluff, on the west shore of Whitefish Bay, about 3 miles south of the Sheldrake River. The station is about 30 feet high and has for a geodetic point a half-inch hole in a flat field stone with letters "U. S." on it and set 2 feet below surface.

Station Tequamenon is on the west side of Tequamenon Island. The station is 14 feet high. The geodetic point is the old mark, a cross cut on a large bowlder.

Station Emerson is on a sand bank at the south side of the mouth of the Tequamenon River. A stone is set there with a small tripod over it.

North Parisian is on the north end of Parisian Island and is very close to where the old station was. Set a stone and a small tripod over it.

Station Goulais Point (1868) is a small tripod placed over the old stone geodetic mark and is on the west side of the point of land that forms Goulais Bay, and is about midway between the south end of Goulais Point and the bay back of Maple Island. The station is on the top of a bank about 20 feet from the beach.

Station Rudder Head (1868) is on the point north of Maple Island and is supposed to be the old point. A stone is set there with a small tripod over it.

Station Rudder Head (1895) is on a rock at the shore at the north end of Rudder Head Point. The geodetic point is a half-inch hole drilled in the rock and the letters "U. S." cut near it.

Station South Shore is on a birch point on the south shore of Batchewana Bay and replaces an old survey post found there. Set a stone here with a small tripod over it.

Station Rock is on the top of a solid rock point on the west side of a small bay at the southeast end of Batchewana Bay. Put up a small tripod over a half-inch hole drilled in the rock with the letters "U. S." cut near it.

Station East Bay is on the west side of a small island at the east end of Batchewana Bay. Put a small tripod over a half-inch hole drilled in the solid rock with the letters "U. S." cut near it.

Station South Pancake is on a small point on the shore of Pancake Bay, about 2 miles north of Corbay Point Light. Cut a half-inch hole in a large flat rock, which was set 12 inches below surface in a pile of broken rock. Letters "U. S." also cut on stone and a small tripod was placed over it.

Station Middle Pancake is on the edge of a bluff at north side of Pancake Bay about 200 feet from shore. Set a stone and a small tripod over it.

Station Steamboat Island is on the east side of an island of the same name close to North Sandy Island. Set a stone here with a small tripod over it.

Station South Sandy is on the south end of South Sandy Island, and replaces the old survey post found there. Set a stone here with a small tripod over it.

Station East Base is on the east edge of a hill on the east end of Batchewana Island. A line from this station to West Base runs along the neck of the island. The station has a tripod 35 feet high.

Station Middle Batchewana is on the neck of the island near the east end, close to the line between East and West Base. A stone set here with a small tripod over it.

The descriptions of the 44 intersection stations in Mud Lake and Potagannissing Bay can be found in my monthly reports for September, October, and November of 1894.

Very respectfully, your obedient servant,

GLEN E. BALCH, *Assistant Engineer.*

First Lieut. CHARLES S. RICHÉ,
Corps of Engineers, U. S. A.

B.—REPORT OF MR. E. E. HASKELL, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., June 30, 1895.

SIR: I have the honor to make the following report of progress on the field work of the angle reading and the reduction of the observations of the primary and secondary triangulation of the resurvey of St. Marys River, for the period covering the fiscal year 1895.

The year covers one field season and part of a second one, besides several months spent in office work. I was in the field in charge of an angle-reading party from July 16 to November 25, 1894, and am now in the field, where I have been since May 6, in charge of a similar party. The remainder of the year, with the exception of the month of March, while I was away on a leave of absence, was spent in office work on the reduction of the observations relating to the triangulation.

During the months of December, January, and February I spent nearly every clear night in the observatory, observing for either azimuth or latitude. These observations have not been reduced, but I think should be, for so far as they go they seem to be very satisfactory. It was my intention to keep up these observations for the interval that I was engaged in office work, but my absence from Sault Ste. Marie during March and the extra labor involved in fitting out for an early start in the field on my return have prevented. It is a difficult matter, however, to obtain a series of continuous observations at this place, for the reason that during the winter months there are so few clear nights. For instance, during December there were two, during January two, and during February four, practically a repetition of what was experienced a year ago when trying to make similar observations.

The field season of 1894 was spent in executing the triangulation of the river from Sault Ste. Marie to Detour. For an idea of this system attention is invited to Pl. I, submitted with your report. The net starts from the primary line Larke–Rankin Mountain in the development from the Soo base, with a pentagon formed by the stations Larke, Rankin Mountain, Laird, Salters Hill, Duke. This pentagon covers a large area to the south and east of Sault Ste. Marie and also about one-half of the length of the river to Detour. The line Rankin Mountain–Laird of the figure gives a base which controls the tertiary triangulation of the river through Lake George, and from it is located the Lake George Flats Light-House, and through this connection several tertiary stations. The line Laird–Salters Hill controls the tertiary triangulation of Hay Lake and the Middle Neebish by the pentagon, 19 Hay Lake, Laird, Salters Hill, Ross, 59 Neebish, which springs from it. Station 19 Hay Lake is identical with ⊙ 19, and 59 Neebish identical with ⊡ 59 of the tertiary triangulation.

This pentagon, with the stations Rocky Point, was located by me during the fiscal year 1894, and is described briefly in my report for that year, marked C, to which attention is invited for a review of the work up to this point. Assistant Engineer Glen E. Balch took up the reconnaisance where I left off and carried it forward to Detour Light-House, building the stations as he went along and at the same time putting in the flag stations.

It should also be explained that these flag stations were located by intersection from the secondary triangulation and were put in to take the place of a tertiary triangulation for controlling the topography and hydrography below Rocky Point, the tertiary triangulation of the river executed by Assistant Engineer Joseph Ripley for improvement purposes having stopped at this place. The positions of these flag stations were well chosen, and they cover very nicely indeed the remaining reach of the river. I am of the opinion, however, that while the system of obtaining points by intersection in general is a good one in this case it was carried to excess, for the work involved in computing the position of some of the flags was very laborious, the computer having to pass through several triangles to get at a single point. Three pointings from triangulation stations, which will give, with the flag station, two well-proportioned adjacent triangles, is in my judgment what is needed and all that is necessary. Beyond this point it will be better to add a few extra ⊙s to con-

trol the work, for triangles with all three angles measured are quickly computed and adjusted.

As stated above, my party took the field July 16. Between this date and November 25, the close of the field season of 1894, the party occupied 5 primary stations and 3 secondary stations, made 20 measures each of 48 secondary angles and read 160 sets of zenith distances.

The stations and the order in which they were occupied were: Larke, Rankin Mountain, Laird, Salters Hill, Duke, 19 Hay Lake, Detour, and Burnt Point. Assistant Engineer Thomas Russell took the field with an angle-measuring party August 22, and between this date and November 25 measured the angles at 19 Hay Lake and the remaining stations of the secondary system. Mr. Russell has made a report upon his work and attention is invited to it for details relating to the stations occupied by him. In explanation, it should be stated that my occupation of 19 Hay Lake in November, after Mr. Russell had occupied it in August, was for the purpose of reading the angle Laird–Salters Hill. This angle had been left by Mr. Russell on account of the difficulty of seeing over the long line to Salters Hill, owing to the smoky condition of the atmosphere at the time.

The weather during most of the season, while good for general purposes, was poor in the extreme for angle reading over lines as long as those involved in the primary system. The forest fires of northern Wisconsin, eastern Minnesota, and the western end of the upper peninsula of Michigan filled the air so full of smoke that from the time the party took the field until October progress was slow in the extreme. There were days during September, while the party was at Laird, that it was impossible to see half a mile. Early in October a general rain storm lasting for several days cleared the atmosphere to such an extent that with the good weather that prevailed for the remainder of the month and for the first half of November good progress was made. From the middle of November until the close of the season frequent snow squalls were a source of annoyance and many times caused the loss of part of a set of angles.

METHODS.

The methods of observing followed during the year were precisely those of last year, given in my report, page 3410 of the Report of the Chief of Engineers for 1894.

The plan of having all targets carefully centered and plumb over the geodetic point and the instrument also carefully centered, making no eccentric stations, has been rigidly adhered to. The limit in closing the horizon and in closing triangles had also been the same, namely, $\pm 2''$ and $180^\circ +$ spherical excess $\pm 3''$ respectively.

The form of target used was the one described in my last year's report, with a few changes as to manner of construction. The bottom plate instead of being solid was a + made of No. 10 band iron $1\frac{1}{4}$ inches wide. It was like the other cross frames of the target with the exception of having a quarter-inch hole at its center, through which a large wire nail was driven to secure the bottom of the target over the geodetic point. The vertical rods of round iron were threaded at each end for about 1 inch, and each end provided with two nuts. Between these nuts the end crosses were locked, the two intermediate crosses being held in place by wire firmly twisted around the rods both above and below them. This method of fastening took the place of soldering and permitted a target being taken to its destination "knocked down," which in the cases of the larger sizes was a great convenience, for many of our stations were difficult to reach, being off from the traveled roads. The zones of cloth were usually prepared in advance by sewing with a machine a broad hem on each side through which the rods could be slipped. The cloth was made just enough narrower than the distance between the opposite rods to secure its being stretched so that it would be smooth when in place. The edges were fastened to the cross frames and to the rods to prevent the wind from shifting them. A good illustration of a 24-inch target made in this manner—one set on ⊙ Rankin Mountain—appears as Pl. III of your report. A bill of material for a target of this size would be 8 pieces of No. 10 band iron $1\frac{1}{4}$ inches wide by 26 inches long, 4 rods of three-eighths round iron 6 feet long, and 8 rivets of soft steel three-sixteenths by five-sixteenths inch. The pieces of band iron would have the necessary holes punched through them for the riveting of two pieces together to form a + and for the rods at their ends, the rods threaded and provided with nuts as explained above.

The flag stations were marked by a combination of black and white flags tacked to a good straight pole, and the pole guyed plumb with wire over the point. These flag stations were numbered, and their number indicated by the arrangement of the flags, so that the observer could tell at a glance the number of the station he saw.

The instrument was the one used last year, namely, Troughton & Simms theodolite No. 3. It has a 14-inch horizontal circle read by three equidistant microscopes and a 12-inch vertical circle read by two equidistant microscopes. All microscopes read to seconds, and tenths may be estimated.

RESULTS.

Of the five primary and the three secondary stations occupied, all fell within the limits, $\pm 2''$, in summing the angles closing the horizon on first trial with the exception of one, the secondary station Burnt Point, at which the angles were measured with a Buff & Berger 10″ transit. The discrepancies are:

At Larke	+0.99
At Rankin Mountain	—0.53
At Laird	+0.33
At Salters Hill	—1.01
At Duke	+0.84
At 19 Hay Lake	—0.40
At Detour	+0.50
At Burnt Point, with the Buff & Berger transit	—7.50

Barring Burnt Point, the greatest discrepancy was 1.01″, the least 0.33″, and the mean 0.55″; 4 closed less than 360° and 3 closed greater than 360°.

I should add that the stations at Larke, Salters Hill, and Duke are 67, 70, and 104 feet high, respectively, and that their height is, in my judgment, the cause of the large discrepancies, they lacking that stability that is obtained in a low station.

The 5 primary stations form a pentagon, with half of one diagonal missing. The summing of the observed angles of the triangles of the various figures which form the triangulation net of the river will be found in the following table marked A.

In accordance with your suggestion, stations 19 Hay Lake, 59 Neebish, Ross, etc., to Detour have been called secondary stations. They form no part in the direct chain of triangles that is to connect Lake Superior with Lakes Huron and Michigan, but simply control the river work from the foot of Hay Lake to Detour. It should be stated, however, that the angles of the triangles forming this system have all been read by the method followed in reading primary angles and that the flag stations have been read in, in accordance with the programme for secondary angles.

In reducing the work the same method has been followed that was adopted last year with one exception, and that is that where quadrilaterals could be formed that were overlapping the figure has been adjusted as a pentagon instead of as two quadrilaterals. The chain of triangles of the season work, extending from Sault Ste. Marie to Detour Light-House, gave 4 pentagons and 4 quadrilaterals, as follows:

First, the pentagon Larke, Rankin Mountain, Laird, Salters Hill, Duke, springing from the line Larke–Rankin Mountain; second, the pentagon 19 Hay Lake, Laird, Salters Hill, Ross, 59 Neebish, springing from the primary line Laird–Salters Hill; third, the pentagon Winter Point, Ross, Salters Hill, Pointe aux Frênes, Rocky Point, springing from the line Ross–Salters Hill; fourth, the quadrilateral Raber, Pointe aux Frênes, Salters Hill, Fort St. Joe, springing from the line Pointe aux Frênes–Salters Hill; fifth, the pentagon Detour, Fort St. Joe, Salters Hill, Bacon Island, Drummond, springing from the line Fort St. Joe–Salters Hill; sixth, the quadrilateral Burnt Point, Bacon Island, Drummond, Detour, springing from the line Bacon Island–Detour; seventh, the quadrilateral Detour, Burnt Point, Bacon Island, Harbor Island, springing from the line Bacon Island–Detour; eighth, the quadrilateral Detour Light-House, Detour, Bacon Island, Drummond, springing from the line Detour–Drummond, and locating the present Detour Light-House.

The old Detour Light-House of 1860 was referred, by obtaining its center from the outline of its foundation which is still traceable, to the present light-house and to ⊙ Detour, by Assistant Engineer Glen E. Balch, and the position of it is given in Table No. 2 of geographic positions.

The results of the computations of the triangulation will be found in Table No 1, and the geographic positions of the primary and secondary stations in Table No. 2

The computations of the triangle sides of the tertiary triangulation of the river from Little Rapids to Rocky Point by way of Lake George, Hay Lake, the Middle Neebish, Sailors Encampment, and the West Neebish were procured from Assistant Engineer Joseph Ripley, under whose direction it was executed and has been compiled, and appears as Table No. 3; the geographic positions of the stations of this system as Table No. 4.

The triangles locating the flag stations between Rocky Point and Detour will be found in Table No. 5; the geographic positions of the flag stations in Table No. 6.

In regard to all computations it should be stated that they have been made in duplicate and checked in all cases where the method or form of computation did not lead to a direct check itself. Where this was the case it was considered sufficient and the work was not duplicated. I am of the opinion that very few, if any, mistakes can be found in the results submitted. There have been connected with and taking part in the computations at one time or another Assistant Engineers Thomas Russell and Glen E. Balch and Recorders H. F. Johnson and J. I. Conklin, all of whom have rendered excellent service.

To my recorder, Mr. R. L. Ames, who assisted me from July 16 to October 14 of the field season of 1894, I desire to express my sincere thanks for faithful and efficient service rendered. Mr. Ames resigned his position to accept an appointment in the United States Patent Office at Washington. I also wish to express my appreciation of similar service rendered by Mr. H. F. Johnson, who took Mr. Ames's place for the remainder of the season of 1894 and who is still with me.

COST OF THE ANGLE READING, SEASON OF 1894.

The total expenses of the angle party, including all salaries for the field season, was $2,569; of this amount, or the expenses of the party from July 16 to September 30, $1,365.83 was paid from the appropriation for the 20 and 21 foot channel, and the remainder, $1,203.17, the expenses of the party from October 1 to November 30, from the appropriation for the survey of the Northern and Northwestern Lakes.

The party was in the field 132 days. During this time 1,531 meals were served in camp. The total cost of groceries and provisions for the season was $204.57, or 13.4 cents per meal. The cost, with the cook's wages, 25.9 cents per meal.

The heliotroping cost $249.31 and transportation $191.86. The cost per station, including everything, $321.12. By referring to my report for last year, page 3412, of the Report of the Chief of Engineers for 1894, it will be seen that the cost per station of the angle reading this year exceeds that of last year by $97.67 per station, which is accounted for by the greater length of lines observed over and by the very poor season for this class of work.

FIELD WORK OF THE SEASON OF 1895.

In my report marked C, page 3403, of the Report of the Chief of Engineers for 1894, I submitted a plan for making the northern connection of the primary triangulation of the river with the old line Gargantua-Mamainse of the Lake Superior (1869) triangulation. This plan was approved by you, and my party, in conjunction with that of Assistant Engineer Thomas Russell, is now in the field engaged in making this connection.

As will be seen by reference to the report above mentioned, this plan depended upon securing the triangle, Crisp-Gargantua-Mamainse, of which the line Crisp-Gargantua could only be seen over at times when refraction was excessive.

The Lake Superior region is noted for cases of excessive refraction, especially in the early spring, as will be seen by reference to the old lake survey reports of work executed on it.

In accordance with your instructions, Assistant Engineer Glen E. Balch built a 100-foot station on the place selected for Crisp during the early Spring, and immediately on its completion, May 6, Mr. Russell's party and mine took the field, Mr. Russell going to Crisp and I going to Gargantua. On reaching Gargantua and getting established in camp, my party went to work immediately and built a station, with two tripods and two platforms, on the site of the old station. The first tripod was about 6 feet high and was used for mounting the instrument. The second tripod was about 15 feet high, and stood directly over the first and was used for mounting the heliotrope. A suitable platform surrounded each tripod. In this way both instrument and heliotrope were kept over the center and could both be used at the same time. The afternoon of May 14 found everything in readiness for heliotroping and observing.

Owing to the length of the old line Gargantua-Mamainse, 42 miles, and that of the line Crisp-Mamainse, 37 miles, a heliotrope was necessary on Mamainse for both Mr. Russell and myself. Accordingly a heliotroping party was fitted out for this station under the direction of my recorder, Mr. H. F. Johnson, and they left for their destination shortly after the observing party started out. △ Mamainse stands on a high bluff that is about 9 miles inland from the landing near Corbay Point-Batchewana Dock, and is reached by an old trail starting from the old ore dock near the mouth of Carp River. This trail follows the old railroad grade for about 4 miles and then leads through the woods in a northwesterly direction for the remainder of the distance.

Mr. Johnson arrived with his party at Batchewana Dock on the tug *Arthur* the morning of May 13. He secured several Indians for packers and arrived at the old △ Mamainse at 9.30 a. m. the next day. The first flash seen at Gargantua from him was shortly after sunrise the morning of the 15th.

Mr. Johnson having everything in good working order and the direction of both heliotrope lines well established, as I learned by letters from him, and needing his services in the azimuth observations to be made at Gargantua, I relieved him by sending on May 26 my observer's attendant, Jacob Bainbridge, to take charge of his party. Mr. Johnson arrived at Gargantua May 29.

The flashing to and looking for a flash from Crisp was kept up in vain until about 4 o'clock of the afternoon of May 27, when the first flash from Mr. Russell was seen. It was visible from time to time for intervals of a few seconds until sundown, and in the meantime 16 measures of the angle Mamainse-Crisp were obtained. The flash of Crisp was seen several times afterwards, namely, on June 1, 3, and 6, and many times more than the angles required could have been read.

The flash coming across water for practically the entire length of the line and being visible only at times of excessive refraction has presented certain peculiarities that seem worthy of note. On May 27 and June 1 and 3 it appeared at about the same time each day, 4 p. m., and remained visible from that hour until sundown. On June 6 it could be seen for nearly the entire day.

Most of the time it would appear as a single flash, but now and again as 2, 3, 4, 5, and as high as 6 were noted, all in a vertical line. These flashes would at times appear all of one color, nearly white, and then of different colors as if the light had come through a prism. This excessive refraction has always occurred after a shift of wind to the north or northwest and the air clearing out in consequence.

At △ Gargantua, five nights azimuth observations were made on Polaris at eastern elongation, reading the angle to an azimuth mark placed on the little island on which Gargantua Light-House stands. This location for the mark was not wholly a desirable one, but the best that could be had without considerable trouble. It is quite a little below the horizon line from the station, but its zenith distance was determined and the striding level was always read when pointing at it.

The magnetic declination at Gargantua was also determined and the results have already been submitted to you. They will not be repeated here, but left for my next annual report, when the observations of the entire field season can be given.

The party made a complete survey of Gargantua Harbor, including triangulation, topography enough to secure the shore line, and the necessary hydrography. The work will be submitted as soon as platted. In regard to the harbor it should be stated, for the benefit of those navigators unacquainted with it, that it is, although small, a most excellent harbor. It is landlocked, with more than an abundance of water at either entrance leading into it and an anchorage ground when once inside that can not be excelled. To enter "keep in the middle of the road" and there is nothing to fear. The southeastern entrance is the best.

The party finished its labors at Gargantua on June 20, and on the 21st moved to △ Mamainse, where the close of the month and the fiscal year still finds them.

In closing, I desire to express my thanks for faithfulness to Jacob Bainbridge, James Doran, Murray Blanchard, Paul St. Pierre, G. Pembroke Tucker, Edgar N. Church, Richard Godfrey, James Mahon, Louis Fisher, and Henry Day, all of whom have been connected with my party in the field work of the triangulation in one capacity or another.

Very respectfully, your obedient servant,

E. E. HASKELL, *Assistant Engineer.*

First Lieut. CHARLES S. RICHÉ,
Corps of Engineers, U. S. A.

TABLE A.—*Observed angles.*

Triangles.	Observed angles.	Triangles.	Observed angles.
	° ′ ″		° ′ ″
Larke	58 37 52.13	19 Hay Lake	60 41 05.14
Rankin Mountain	82 44 22.26	Laird	84 01 47.52
Laird	38 37 46.35	Salters Hill	35 17 07.82
	180 00 00.74		180 00 00.48
Spherical excess	$\epsilon =$ 1.039	Spherical excess	$\epsilon =$ 0.946
Closing error	+ 00.299	Closing error	+ 00.466
Larke	87 16 44.41	Rocky Point	66 08 51.17
Laird	40 23 11.02	Ross	70 32 55.74
Duke	52 20 06.31	Salters Hill	43 18 14.68
	180 00 01.74		180 00 01.59
Spherical excess	$\epsilon =$ 1.581	Spherical excess	$\epsilon =$ 00.191
Closing error	— 00.159	Closing error	— 01.399
Rankin Mountain	63 24 01.08	Rocky Point	109 48 21.15
Laird	79 00 57.07	Winter Point	50 18 56.96
Duke	37 35 03.15	Salters Hill	19 52 44.65
	180 00 01.30		180 00 02.76
Spherical excess	$\epsilon =$ 2.063	Spherical excess	$\epsilon =$ 0.119
Closing error	+ 0.763	Closing error	— 02.641
Salters Hill	68 32 46.77	Rocky Point	43 39 29.98
Laird	72 00 14.88	Winter Point	99 32 23.17
Duke	39 26 57.38	Ross	36 48 06.90
	179 59 59.03		180 00 00.05
Spherical excess	$\epsilon =$ 2.000	Spherical excess	$\epsilon =$ 0.064
Closing error	+ 02.970	Closing error	+ 00.014
Salters Hill	31 53 19.82	Pointe aux Frênes	79 15 09.32
Duke	91 47 03.56	Rocky Point	45 36 30.61
Larke	56 19 38.02	Salters Hill	55 08 20.58
	180 00 01.40		180 00 00.51
Spherical excess	$\epsilon =$ 2.041	Spherical excess	$\epsilon =$ 0.171
Closing error	+ 0.641	Closing error	— 00.339
Ross	109 24 44.74	Pointe aux Frênes	70 47 58.95
Laird	24 09 47.88	Winter Point	34 10 58.76
Salters Hill	46 25 28.27	Salters Hill	75 01 05.23
	180 00 00.89		180 00 02.94
Spherical excess	$\epsilon =$ 0.451	Spherical excess	$\epsilon =$ 0.247
Closing error	— 0.439	Closing error	— 02.693
59 Neebish	106 24 40.60	Fort St. Joe	28 05 08.07
Laird	43 04 23.29	Pointe aux Frênes	114 47 55.54
Salters Hill	30 30 59.16	Salters Hill	37 06 56.29
	180 00 03.05		179 59 59.90
Spherical excess	$\epsilon =$ 0.519	Spherical excess	$\epsilon =$ 0.177
Closing error	— 02.531	Closing error	+ 00.277
59 Neebish	128 24 16.47	Raber	78 50 25.32
Laird	18 54 33.39	Salters Hill	25 31 50.31
Ross	32 41 10.73	Fort St. Joe	75 37 44.41
	180 00 00.59		180 00 00.04
Spherical excess	$\epsilon =$ 0.189	Spherical excess	$\epsilon =$ 0.241
Closing error	— 00.401	Closing error	+ 00.201
19 Hay Lake	52 52 04.19	Raber	91 05 57.64
Laird	40 57 24.23	Pointe aux Frênes	41 21 26.48
59 Neebish	86 10 29.82	Fort St. Joe	47 32 36.34
	179 59 58.24		180 00 00.46
Spherical excess	$\epsilon =$ 0.330	Spherical excess	$\epsilon =$ 0.122
Closing error	+ 02.09	Closing error	— 00.338

TABLE A.—*Observed angles*—Continued.

Triangles.	Observed angles.			Triangles.	Observed angles.		
	°	′	″		°	′	″
Bacon Island	47	24	30.69	Burnt Point	57	50	23.44
Fort St. Joe	105	14	02.21	Bacon Island	91	33	22.69
Salters Hill	27	21	27.54	Detour	30	36	18.13
	180	00	00.44		180	00	04.26
Spherical excess			ϵ = 00.340	Spherical excess			ϵ = 0.141
Closing error			— 00.10	Closing error			— 04.119
Drummond	48	57	36.62	Drummond	30	46	33.04
Salters Hill	15	36	56.33	Burnt Point	38	08	38.54
Bacon Island	115	25	25.37	Bacon Island	111	04	51.47
	179	59	58.32		180	00	03.05
Spherical excess			ϵ = 0.313	Spherical excess			ϵ = 0.096
Closing error			+ 1.993	Closing error			— 02.954
Drummond	67	58	58.52	Detour	37	31	56.75
Fort St. Joe	44	00	06.08	Bacon Island	19	31	28.78
Bacon Island	68	00	54.68	Drummond	122	56	34.37
	179	59	59.28		179	59	59.90
Spherical excess			ϵ = 0.153	Spherical excess			ϵ = 0.057
Closing error			+ 0.873	Closing error			+ 00.157
Detour	63	44	17.84	Harbor Island	57	06	45.52
Fort St. Joe	67	46	17.56	Detour	47	14	52.16
Bacon Island	48	29	25.90	Burnt Point	75	38	23.86
	180	00	01.30		180	00	01.54
Spherical excess			ϵ = 0.170	Spherical excess			ϵ = 0.277
Closing error			— 01.13	Closing error			— 01.263
Detour	101	16	14.59	Harbor Island	21	47	21.66
Fort St. Joe	23	46	11.48	Bacon Island	140	24	33.08
Drummond	54	57	35.85	Burnt Point	17	48	07.92
	180	00	01.92		180	00	02.66
Spherical excess			ϵ = 0.074	Spherical excess			ϵ = 0.045
Closing error			— 01.846	Closing error			—02.615

TABLE NO. 1.—*The primary and secondary triangulation.*

Stations.	Observed angles.	Local correction.	General correction.	Total correction.	Adjusted spherical angles.	Plane angles.	Logarithmic sines.	Logarithmic sides.	Sides.
	° ′ ″	″	″	″	° ′ ″	° ′ ″		*Meters.*	*Meters.*
Laird	38 37 46.35	−0.280	+0.121	−0.159	38 37 46.191	38 37 45.845	9.7953798	4.2401376	17,383.516
Larke	58 37 52.13	+0.604	−0.185	+0.419	58 37 52.549	58 37 52.203	9.9313735	4.3761313	23,775.590
Rankin Mountain	82 44 22.26	−0.114	+0.153	+0.039	82 44 22.299	82 44 21.952	9.9965036	4.4412614	27,622.401
					ϵ=1.039				
Duke	52 20 06.07	+0.248	+0.030	+0.278	52 20 06.348	52 20 05.821	9.8985038	4.4412614	27,622.401
Larke	87 16 44.41	+0.604	−0.556	+0.048	87 16 44.458	87 16 43.931	9.9995100	4.5422676	34,855.202
Laird	40 23 11.02	+0.235	−0.480	−0.245	40 23 10.775	40 23 10.248	9.8115322	4.3542898	22,609.437
					ϵ=1.581				
Duke	37 35 03.15	+0.019	+0.397	+0.416	37 35 03.566	37 35 02.879	9.7852770	4.3761313	23,775.590
Rankin Mountain	63 24 01.08	+0.382	+0.069	+0.451	63 24 01.531	63 24 00.843	9.9514133	4.5422676	34,855.202
Laird	79 00 57.07	+0.255	−0.359	−0.104	79 00 56.966	79 00 56.278	9.9919696	4.5828239	38,266.956
					ϵ=2.063				
Salters Hill	68 32 47.00	+0.110	+1.109	+1.219	68 32 48.219	68 32 47.552	9.9688167	4.5422676	34,855.202
Laird	72 00 14.88	+0.490	+0.007	+0.497	72 00 15.377	72 00 14.710	9.9782164	4.5516673	35,617.820
Duke	39 26 57.38	+0.267	+0.757	+1.024	39 26 58.404	39 26 57.738	9.8030446	4.3764955	23,795.535
					ϵ=2.000				
Larke	56 19 38.02	−0.694	−0.226	−0.920	56 19 37.100	56 19 36.420	9.9202347	4.5516673	35,617.820
Salters Hill	31 53 19.82	−0.450	+0.820	+0.370	31 53 20.190	31 53 19.510	9.7228573	4.3542899	22,609.443
Duke	91 47 03.45	+0.515	+0.786	+1.301	91 47 04.751	91 47 04.070	9.9997893	4.6312219	42,778.139
					ϵ=2.041				
Ross	109 24 44.74	+0.241	−0.298	−0.057	109 24 44.683	109 24 44.533	9.9745816	4.3764955	23,795.535
Laird	24 09 47.88	+0.505	−0.217	+0.288	24 09 48.168	24 09 48.018	9.6120835	4.0139974	10,327.552
Salters Hill	46 25 28.27	−0.483	−0.187	−0.670	46 25 27.600	46 25 27.449	9.8600169	4.2619308	18,278.088
					ϵ=0.451				
59 Neebish	106 24 40.60	−0.201	−0.149	−0.350	106 24 40.250	106 24 40.077	9.9819360	4.3764955	23,795.535
Laird	43 04 21.27	+1.009	−0.094	+0.915	43 04 22.185	43 04 22.012	9.8343741	4.2289336	16,940.789
Salters Hill	30 30 58.11	+0.105	−0.131	−0.026	30 30 58.084	30 30 57.911	9.7056758	4.1002353	12,596.076
					ϵ=0.519				

TABLE NO. 1.—*The primary and secondary triangulation*—Continued.

Stations.	Observed angles.	Local correction.	General correction.	Total correction.	Adjusted spherical angles.	Plane angles.	Logarithmic sines.	Logarithmic sides.	Sides.
	° ′ ″	″	″	″	° ′ ″	° ′ ″		*Meters.*	*Meters.*
59 Neebish	128 24 16.47	−0.400	−0.321	−0.721	128 24 15.749	128 24 15.686	9.8941200	4.2619308	18,278.088
Ross	32 41 10.73	+0.240	−0.550	−0.310	32 41 10.420	32 41 10.357	9.7324242	4.1002350	12,596.067
Laird	18 54 33.39	+0.505	+0.125	+0.630	18 54 34.020	18 54 33.957	9.5106430	3.8784538	7,558.816
					ϵ=0.189				
19 Hay Lake	52 52 04.19	−0.200	+0.724	+0.524	52 52 04.714	52 52 04.604	9.9015925	4.1002350	12,596.067
Laird	40 57 24.23	+0.505	+0.533	+1.038	40 57 25.268	40 57 25.158	9.8165676	4.0152101	10,356.431
59 Neebish	86 10 29.82	−0.200	+0.728	+0.528	86 10 30.348	86 10 30.238	9.9990315	4.1976740	15,764.275
					ϵ=0.330				
19 Hay Lake	60 41 05.14	+0.465	−0.087	+0.378	60 41 05.518	60 41 05.203	9.9404862	4.3764951	23,795.513
Laird	84 01 47.52	−0.505	+0.441	−0.064	84 01 47.456	84 01 47.140	9.9976380	4.4336469	27,142.319
Salters Hill	35 17 07.82	−0.253	+0.405	+0.152	35 17 07.972	35 17 07.657	9.7616651	4.1976740	15,764.275
					ϵ=0.946				
Rocky Point	66 08 51.17	−0.130	−0.749	−0.879	66 08 50.291	66 08 50.227	9.9612255	4.0139974	10,327.552
Ross	70 32 55.74	+0.240	+0.480	+0.720	70 32 56.460	70 32 56.396	9.9744779	4.0272498	10,647.553
Salters Hill	43 18 14.68	−0.298	−0.942	−1.240	43 18 13.440	43 18 13.377	9.8362390	3.8890109	7,744.812
					ϵ=0.191				
Winter Point	50 18 56.96	−0.070	−1.577	−1.647	50 18 55.313	50 18 55.273	9.8862485	4.0272498	10,647.553
Salters Hill	19 52 44.65	−0.149	−0.271	−0.420	19 52 44.230	19 52 44.191	9.5315223	3.6725236	4,704.610
Rocky Point	109 48 21.15	−0.260	−0.314	−0.574	109 48 20.576	109 48 20.536	9.9735190	4.1145203	13,017.281
					ϵ=0.119				
Ross	36 48 06.90	+0.240	+0.294	+0.534	36 48 07.434	36 48 07.413	9.7774648	3.6725236	4,704.610
Rocky Point	43 39 29.98	−0.130	+0.435	+0.305	43 39 30.285	43 39 30.263	9.8390740	3.7341328	5,421.666
Winter Point	99 32 22.65	+0.040	−0.344	−0.304	99 32 22.346	99 32 22.324	9.9939525	3.8890113	7,744.820
					ϵ=0.065				
Pointe aux Frenês	79 15 09.32	+0.210	+0.075	+0.285	79 15 09.605	79 15 09.548	9.9923144	4.0272498	10,647.553
Rocky Point	45 36 30.61	−0.130	+0.150	+0.020	45 36 30.630	45 36 30.573	9.8540487	3.8889841	7,744.334
Salters Hill	55 08 20.58	−0.149	−0.495	−0.644	55 08 19.936	55 08 19.879	9.9140996	3.9490350	8,892.729
					ϵ=0.171				

Pointe aux Frenês	70	47	58.95	−0.100	−0.560	−0.660	70	47	58.290	70	47	58.208	9.9751438	4.1145203	13,017.286
Winter Point	34	10	58.76	+0.040	−1.008	−0.968	34	10	57.792	34	10	57.710	9.7496077	3.8889842	7,744.336
Salters Hill	75	01	05.23	−0.298	−0.767	−1.065	75	01	04.165	75	01	04.082	9.9849799	4.1243564	13,315.461
									ϵ=0.247						
Fort St. Joe	28	05	08.07	−0.090	+0.412	+0.322	28	05	08.392	28	05	08.333	9.6728280	3.8889842	7,744.336
Pointe aux Frenês	114	47	55.54	+0.100	−0.073	+0.027	114	47	55.567	114	47	55.508	9.9579838	4.1741400	14,932.756
Salters Hill	37	06	55.73	+0.088	+0.400	+0.488	37	06	56.218	37	06	56.159	9.7806234	3.9967796	9,926.123
									ϵ=0.177						
Raber	78	50	25.32	−0.270	+0.361	+0.091	78	50	25.411	78	50	25.330	9.9917096	4.1741400	14,932.756
Salters Hill	25	31	50.31	−0.236	−0.101	−0.337	25	31	49.973	25	31	49.893	9.6344691	3.8168995	6,559.935
Fort St. Joe	75	37	44.41	−0.180	+0.627	+0.447	75	37	44.857	75	37	44.777	9.9861935	4.1686239	14,744.292
									ϵ=0.241						
Raber	91	05	56.84	+0.260	−0.197	+0.063	91	05	56.903	91	05	36.862	9.9999201	3.9967796	9,926.123
Pointe aux Frenês	41	21	26.48	+0.090	+0.184	+0.274	41	21	26.754	41	21	26.713	9.8200399	3.8168994	6,559.933
Fort St. Joe	47	32	36.34	−0.090	+0.216	+0.126	47	32	36.466	47	32	36.425	9.8679324	3.8647919	7,324.735
									ϵ=0.123						
Bacon Island	47	24	30.69	−0.240	+0.411	+0.171	47	24	30.861	47	24	30.748	9.8669946	4.1741400	14,932.756
Fort St. Joe	105	14	02.21	−0.090	−0.147	−0.237	105	14	01.973	105	14	01.859	9.9844649	4.2916103	19,570.878
Salters Hill	27	21	27.54	−0.298	+0.264	−0.034	27	21	27.506	27	21	27.393	9.6623260	3.9694714	9,321.191
									ϵ=0.340						
Drummond	48	57	36.62	+0.330	+0.259	+0.589	48	57	37.209	48	57	37.105	9.8775181	4.2916103	19,570.878
Salters Hill	15	36	56.33	−0.149	+0.434	+0.285	15	36	56.615	15	36	56.511	9.4300487	3.8441409	6,984.590
Bacon Island	115	25	24.50	+1.120	+0.869	+1.989	115	25	26.489	115	25	26.384	9.9557626	4.3698548	23,434.452
									ϵ=0.313						
Drummond	67	58	58.27	+0.660	−0.024	+0.636	67	58	58.906	67	58	58.855	9.9671138	3.9694713	9,321.189
Fort St. Joe	44	00	06.08	−0.090	−0.371	−0.461	44	00	05.619	44	00	05.568	9.8417834	3.8441409	6,984.590
Bacon Island	68	00	53.78	+1.390	+0.458	+1.848	68	00	55.628	68	00	55.577	9.9672131	3.9695706	9,323.320
									ϵ=0.153						
Detour	63	44	17.84	−0.282	−0.574	−0.856	63	44	16.984	63	44	16.927	9.9526861	3.9694713	9,321.189
Fort St. Joe	67	46	17.56	−0.180	−0.937	−1.117	67	46	16.443	67	46	16.386	9.9664612	3.9832464	9,621.580
Bacon Island	48	29	25.90	+0.640	+0.203	+0.843	48	29	26.743	48	29	26.687	9.8743941	3.8911793	7,783.579
									ϵ=0.170						

TABLE NO. 1.—*The primary and secondary triangulation*—Continued.

Stations.	Observed angles.			Local correction.	General correction.	Total correction.	Adjusted spherical angles.			Plane angles.			Logarithmic sines.	Logarithmic sides.	Sides.
	°	′	″	″	″	″	°	′	″	°	′	″		*Meters.*	*Meters.*
Detour	101	16	14.06	+0.390	—1.079	—0.689	101	16	13.371	101	16	13.346	9.9915432	3.9695706	9,323.320
Fort St. Joe	23	46	11.48	—0.090	—0.566	—0.656	23	46	10.824	23	46	10.800	9.6053706	3.5833980	3,831.758
Drummond	54	57	35.85	+0.540	—0.511	+0.029	54	57	35 879	54	57	35.854	9.9131519	3.8911793	7,783.579
									ϵ=0.074						
Burnt Point	57	50	23.44	—4.267	—0.835	—5.102	57	50	18.338	57	50	18.291	9.9276527	3.9832464	9,621.580
Bacon Island	91	33	22.69	+1.540	—0.728	+0.812	91	33	23.502	91	33	23.455	9.9998397	4.0554334	11,361.440
Detour	30	36	18.13	+0.104	+0.067	+0.171	30	36	18.301	30	36	18.254	9.7068181	3.7624118	5,786.444
									ϵ=0.141						
Drummond	30	46	33.04	+0.210	—0.637	—0.427	30	46	32.613	30	46	32.581	9.7089974	3.7624118	5,786.444
Burnt Point	38	08	38.54	—2.133	—0.660	—2.793	38	08	35.747	38	08	35.715	9.7907282	3.8441426	6,984.617
Bacon Island	111	04	50.57	+2.290	—1.124	+1.166	111	04	51.736	111	04	51.704	9.9699155	4.0233299	10,551.881
									ϵ=0.096						
Harbor Island	57	06	45.51	—3.490	+0.960	—2.530	57	06	42.980	57	06	42.888	9.9241411	4.0554334	11,361.440
Detour	47	14	52.16	—0.215	—0.352	—0.567	47	14	51.593	47	14	51.501	9.8658703	3.9971626	9,934.880
Burnt Point	75	38	23.86	+1.100	+0.744	+1.844	75	38	25.704	75	38	25.611	9.9862155	4.1175078	13,107.136
									ϵ=0.277						
Harbor Island	21	47	21.65	—2.330	+0.391	—1.939	21	47	19.711	21	47	19.696	9.5695921	3.7624118	5 786.444
Bacon Island	140	24	33.08	—0.260	+0.444	+0.184	140	24	33.264	140	24	33.249	9.8043437	3.9971634	9,934.898
Burnt Point	17	48	07.92	—2.133	+1.283	—0.850	17	48	07.070	17	48	07.055	9.4853350	3.6781547	4,766.008
									ϵ=0.045						
Detour Light							36	28	33.751	36	28	33.737	9.7741421	3.5833980	3,831.758
Detour	98	29	49.85	+0.213	+0.036	+0.249	98	29	50.099	98	29	50.084	9.9952064	3.8044623	6,374.737
Drummond	45	01	35.96	+0.540	—0.306	+0.234	45	01	36.194	45	01	36.179	9.8496874	3.6589433	4,559.774
									ϵ=0.044						
Detour Light							30	11	06.801	30	11	06.775	9.7013926	3.9832464	9,621.580
Detour	136	01	46.45		+0.036	+0.036	136	01	46.486	136	01	46.460	9.8415390	4.1233928	13,285.957
Bacon Island	13	47	06.285		+0.505	+0.505	13	47	06.790	13	47	06.765	9.3770927	3.6589465	4,559.807
									ϵ=0.077						

TABLE NO 2.—*The primary and secondary triangulation—Geographical positions—The Clarke spheroid of 1866.*

Stations.	Latitude.	Seconds in meters.	Longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To stations.	Distances.	Logarithms.
Primary:	° ′ ″		° ′ ″		° ′ ″	° ′ ″		*Meters.*	
Larke	46 27 35.612	1,099.6	84 23 12.327	263.1	223 44 55.52	43 51 45.08	Rankin Mountain	17,383.516	4.2401376
					282 22 48.06	102 38 03.27	Laird	27,622.401	4.4412614
					369 39 32.52	189 37 24.34	Duke	22,609.437	4.3542898
Rankin Mountain	46 34 21.906	676.4	84 13 47.849	1,019.1	321 07 22.78	141 15 49.46	Laird	23,775.590	4.3761313
					355 37 09.14		Salters Hill		
					24 31 24.31	204 22 27.12	Duke	38,266.956	4.5828239
					43 51 45.08	223 44 55.52	Larke	17,383.516	4.2401376
Laird	46 24 21.880	675.6	84 02 09.230	197.2	350 14 37.11	170 16 53.07	Salters Hill	23,795.535	4.3764955
					62 14 52.49	241 57 30.69	Duke	34,855.202	4.5422676
					102 38 03.27	282 22 48.06	Larke	27,622.401	4.4412614
					141 15 49.46	321 07 22.78	Rankin Mountain	23,775.590	4.3761313
					14 24 25.28	194 21 51.78	Ross	18,278.088	4.2619308
					33 18 59.29	213 15 05.30	59 Neebish	12,596.076	4.1002353
					74 16 24.56	254 07 50.60	19 Hay Lake	15,764.275	4.1976740
Salters Hill	46 11 42.323	1,306.8	83 59 01.180	25.3	101 44 04.85	281 24 29.09	Duke	35,617.820	4.5516673
					133 37 25.04	313 19 55.42	Larke	42,778.139	4.6312219
					170 16 53.07	350 14 37.11	Laird	23,795.535	4.3764955
					320 56 28.37	141 03 21.93	Bacon Island	19,570.878	4.2916103
					336 33 24.98	156 37 37.18	Drummond	23,434.452	4.3698548
					348 17 55.88	168 19 37.45	Fort St. Joe	14,932.756	4.1741400
					13 49 45.85	193 47 47.63	Raber	14,744.292	4.1686239
					25 24 52.09	205 23 00.42	Pointe aux Frênes	7,744.336	3.8889842
					80 33 12.03	260 27 18.67	Rocky Point	10,647.553	4.0272498
					100 25 56.26	280 18 45.13	Winter Point	13,017.281	4.1145203
					123 51 25.47	303 46 36.42	Ross	10,327.552	4.0139974
					134 59 45.10	314 48 56.12	19 Hay Lake	27,142.319	4.4336469
					139 45 54.99	319 39 45.55	59 Neebish	16,940.789	4.2289336
Duke	46 15 33.715	1,041.0	84 26 09.449	202.3	189 37 24.34	369 39 32.52	Larke	22,609.437	4.3542898
					204 22 27.12	24 31 24.31	Rankin Mountain	38,266.956	4.5828239
					241 57 30.69	62 14 52.49	Laird	34,855.202	4.5422676
					281 24 29.09	101 44 04.85	Salters Hill	35,617.820	4.5516673
Secondary:									
19 Hay Lake	46 22 02.892	89.3	84 13 59.118	1,263.7	254 07 50.60	74 16 24.57	Laird	15,764.275	4.1976740
					306 59 55.31	127 04 34.95	59 Neebish	10,356.431	4.0152101
					314 48 56.12	134 59 49.10	Salters Hill	27,142.319	4.4336469
59 Neebish	46 18 40.862	1,261.7	84 07 32.565	696.8	127 04 34.95	306 59 55.31	19 Hay Lake	10,356.431	4.0152101
					213 15 05.30	33 18 59.29	Laird	12,596.067	4.1002353
					319 39 45.55	139 45 54.99	Salters Hill	16,940.789	4.2289336
					341 39 21.05	161 40 41.36	Ross	7,558.816	3.8784538

TABLE NO. 2.—*The primary aud secondary triangulation—Geographical positions—The Clarke spheroid of 1886*—Continued.

Stations.	Latitude.	Seconds in meters.	Longitude.	Seconds in meters.	Azimuth.	Back azimuth.	To stations.	Distances.	Logarithmus.
Secondary—Continued.	° ′ ″		° ′ ″		° ′ ″	° ′ ″		*Meters.*	
Ross	46 14 48.476	1,496.8	84 05 41.524	88.94	161 40 41.36	341 39 21.05	59 Neebish	7,558.816	3.8784538
					194 21 51.78	14 24 25.28	Laird	18,278.088	4.2619308
					303 46 36.42	123 51 25.47	Salters Hill	10,327.552	4.0139974
					14 19 32.88	194 18 28.38	Rocky Point	7,744.812	3.8890109
					51 07 40.31	231 05 18.10	Winter Point	5,421.666	3.7341328
Winter Point	46 12 58.229	1,798.0	84 08 58.451	1,252.8	231 05 18.10	51 07 40.31	Ross	5,421.666	3.7341328
					280 18 45.13	100 25 56.26	Salters Hill	13,017.281	4.1145203
					330 37 40.45	150 38 58.09	Rocky Point	4,704.610	3.6725236
Rocky Point	46 10 45.432	1,402.8	84 07 10.868	233.1	150 38 58.09	330 37 40.45	Winter Point	4,704.610	3.6725236
					194 18 28.38	14 19 32.88	Ross	7,744.812	3.8890109
					260 27 18.69	80 33 12.03	Salters Hill	10,647.553	4.0272498
					306 03 49.30	126 07 50.81	Pointe aux Frênes	8,892.729	3.9490350
Pointe aux Frênes	46 07 55.746	1,721.3	84 01 36.002	772.8	126 07 50.81	306 03 49.30	Rocky Point	8,892.729	3.9490350
					134 35 02.13	.....	Winter Point	13,315.466	4.1243564
					205 23 00.42	25 24 52.09	Salters Hill	7,744.336	3.8889842
					320 10 55.98	140 14 29.06	Fort St. Joe	9,926.123	3.9967796
					1 32 22.74	181 32 16.14	Raber	7,324.735	3.8647919
Raber	46 03 58.597	1,809.4	84 01 45.159	970.6	181 32 16.14	1 32 22.74	Pointe aux Frênes	7,324.735	3.8647919
					193 47 47.63	13 49 45.85	Salters Hill	14,744.292	4.1686239
					272 38 13.04	92 41 52.60	Fort St. Joe	6,559.935	3.8168995
Fort St. Joe	46 03 48.710	1,504.1	83 56 40.278	865.7	92 41 52.60	272 38 13.04	Raber	6,559.935	3.8168995
					140 14 29.06	320 10 55.98	Pointe aux Frênes	9,926.123	3.9967796
					168 19 37.45	348 17 55.88	Salters Hill	14,932.756	4.1741400
					273 33 39.43	93 38 51.07	Bacon Island	9,321.191	3.9694714
					317 33 45.05	137 37 15.48	Drummond	9,323.320	3.9695706
					341 19 55.87	161 21 19.19	Detour	7,783.579	3.8911793
Bacon Island	46 03 29.731	918.0	83 49 27.484	590.9	25 37 55.44	205 36 14.39	Drummond	6,984.590	3.8441409
					45 09 24.33	225 05 36.18	Detour	9,621.580	3.9832464
					93 38 51.07	273 33 39.43	Fort St. Joe	9,321.191	3.9694714
					136 42 47.83	316 40 34.74	Burnt Point	5,786.444	3.7624118
					141 03 21.93	320 56 28.37	Salters Hill	19,570.878	4.2916103
					277 07 21.04	97 09 59.43	Harbor Island	4,766.008	3.6781547
Drummond	46 00 05.750	177.5	83 51 47.903	1,030.8	37 38 03.41	217 35 53.43	Detour Light-house	6,374.737	3.8044623
					82 39 39.60	262 37 32.56	Detour	3,831.758	3.5833980
					137 37 15.48	317 33 45.05	Fort St. Joe	9,323.320	3.9695706
					156 37 37.18	336 33 24.98	Salters Hill	23,434.452	4.3698548
					174 49 41.78	354 49 10.79	Burnt Point	10,551.881	4.0233299
					205 36 14.39	25 37 55.44	Bacon Island	6,984.590	3.8441409

Detour	45	59	49.859	1,539.5	83	54	44.505	957.6	161	21	19.19	341	19	55.87
									194	29	18.11	14	30	53.38
									225	05	36.18	45	09	24.33
									241	44	09.71	61	50	36.16
									262	37	32.56	82	39	39.60
									1	07	22.66	181	07	19.68
Detour Light-house (present one, 1895).	45	57	22.203	685.6	83	54	48.655	1,047.9	181	07	19.68	1	07	22.68
									217	35	53.43	37	38	03.41
									285	58	14.12	.....		
Detour Light-house (of 1860)	45	57	22.111	682.7	83	54	48.195	1,038.0	.....			.....		
Burnt Point	46	05	46.113	1,423.9	83	52	32.181	691.2	298	52	27.67	118	57	19.14
									316	40	34.74	136	42	47.83
									354	49	10.79	174	49	41.78
									14	30	53.38	194	29	18.11
Harbor Island	46	03	10.533	325.2	83	45	47.497	1,021.1	61	50	36.16	241	44	09.71
									97	09	59.43	277	07	21.04
									118	57	19.14	298	52	27.67

Fort St. Joe	7,783.579	3.8911793
Burnt Point	11,361.440	4.0554334
Bacon Island	9,621.580	3.9832464
Harbor Island	13,107.136	4.1175078
Drummond	3,831.758	3.5833980
Detour Light-house	4,559.774	3.6589433
Detour	4,559.774	3.6589433
Drummond	6,374.737	3.8044623
Detour Light-house (of 1860).	10.307	1.0131847
Harbor Island	9,934.880	3.9971626
Bacon Island	5,786.444	3.7624118
Drummond	10,551.881	4.0233299
Detour	11,361.440	4.0554334
Detour	13,107.136	4.1175078
Bacon Island	4,766.008	3.6781547
Burnt Point	9,934.880	3.9971626

TABLE NO. 3.—*Tertiary triangulations, St. Marys River, by all channels, between Little Rapids and Rocky Point.*

Stations.	Adjusted angles.			Sides.	Stations.	Adjusted angles.			Sides.
	°	′	″	*Meters.*		°	′	″	*Meters.*
△ 21	55	28	46.55	1,270.38	△ 17	74	00	42.15	3,046.00
△ 23	59	35	11.56	1,329.70	△ 19	38	09	21.50	1,957.55
△ 14	64	56	01.89	1,396.66	△ 18	67	49	56.35	2,934.37
△ 23	64	06	34.35	1,425.11	△ 18	59	58	40.53	2,761.58
△ 25	53	19	01.96	1,270.38	△ 20	72	44	51.09	3,046.00
△ 14	62	34	23.69	1,406.06	△ 19	47	16	28.38	2,343.06
△ 25	88	13	30.35	1,516.63	△ 20	96	31	19.78	3,737.36
△ 16	69	55	06.36	1,425.11	△ 75	47	14	02.71	2,761.58
△ 14	21	51	23.29	564.90	△ 19	36	14	37.51	2,224.00
△ 16	56	21	54.45	1,282.12	△ 19	56	15	39.53	3,107.90
△ 4 U	80	01	17.44	1,516.63	△ 21	90	00	12.64	3,737.36
△ 14	43	36	48.11	1,062.22	△ 75	33	44	07.83	2,075.58
△ 14	63	20	02.35	1,446.63	△ 75	80	44	14.70	3,766.06
△ 1	52	22	27.26	1,282.12	△ 73	54	32	09.06	3,107.90
△ 4 U	64	17	30.39	1,458.58	△ 21	44	43	36.24	2,685.29
△ 4 U	59	27	23.05	1,427.90	△ 21	82	28	58.62	3,800.69
△ 6	60	45	17.34	1,446.63	△ 76	79	13	34.25	3,766.06
△ 1	59	47	19.61	1,432.76	△ 73	18	17	27.13	1,203.15
△ 1	39	47	27.56	1,033.00	△ 76	38	38	40.07	2,389.43
△ 3	62	12	28.45	1,427.90	△ 73	58	01	06.47	3,245.48
△ 6	78	00	03.99	1,578.84	△ 77	83	20	13.46	3,800.69
△ 3	50	45	54.75	1,195.42	△ 76	46	41	51.53	2,371.12
△ 8	42	00	54.06	1,033.00	△ 78	84	55	36.44	3,245.48
△ 6	87	13	11.19	1,541.54	△ 77	48	22	32.03	2,435.53
△ 6	41	42	35.96	985.52	△ 77	32	52	16.27	1,300.76
△ 5	53	48	36.55	1,195.42	△ 79	98	21	44.36	2,371.12
△ 8	84	28	47.49	1,474.33	△ 78	48	45	59.37	1,802.31
△ 5	79	48	37.85	1,250.50	△ 78	52	32	00.83	2,069.86
△ 7	50	51	59.46	985.52	△ 80	20	55	11.54	1,300.76
△ 8	49	19	22.69	963.57	△ 79	97	32	47.63	2,585.25
△ 8	47	32	38.54	1,034.12	△ 79	23	39	24.06	843.63
△ 10	63	08	50.85	1,250.50	△ 81	79	53	28.07	2,069.86
△ 7	69	18	30.61	1,311.22	△ 80	76	27	07.87	2,044.01
△ 7	79	21	03.45	1,460.64	△ 81	86	31	35.47	1,189.91
△ 9	44	05	27.56	1,034.12	△ 82	45	02	50.36	843.63
△ 10	56	33	28.99	1,240.19	△ 80	48	25	34.17	891.82
△ 9	75	02	07.56	2,350.66	△ 80	27	30	45.27	556.03
△ 12	36	53	27.95	1,460.64	△ 83	81	19	43.16	1,189.91
△ 10	68	04	24.49	2,257.18	△ 82	71	09	31.57	1,139.18
△ 10	45	57	35.25	1,741.52	△ 82	57	36	03.43	632.72
△ 11	75	59	52.66	2,350.66	△ 85	47	54	06.44	556.03
△ 12	58	02	32.09	2,055.47	△ 83	74	29	50.13	722.11
△ 12	87	33	44.46	1,994.82	△ 83	29	56	49.13	329.11
△ 14	60	43	33.95	1,741.65	△ 84	73	41	01.24	632.72
△ 11	31	42	41.59	1,049.50	△ 85	76	22	09.63	640.70
△ 11	58	16	38.78	2,128.92	△ 84	68	08	43.04	572.46
△ 13	52	50	50.27	1,994.83	△ 86	32	14	51.73	329.11
△ 14	68	52	30.95	2,334.64	△ 85	79	36	25.23	606.67
△ 14	53	01	49.95	2,142.28	△ 85	43	24	31.97	468.08
△ 16	52	33	30.04	2,128.92	△ 87	57	11	16.76	572.46
△ 13	74	24	40.01	2,582.70	△ 86	79	24	11.27	669.52
△ 13	62	31	15.87	1,960.58	△ 86	82	40	26.87	1,097.04
△ 15	75	47	20.92	2,142.28	△ 88	24	06	37.66	468.08
△ 16	41	41	23.21	1,469.81	△ 87	73	12	55.47	1,136.50
△ 16	84	41	52.82	2,665.23	△ 87*	31	35	55.6	592.62
△ 18	47	05	36.17	1,960.58	△ 89*	75	55	12.9	1,097.04
△ 15	48	12	31.01	1,995.66	△ 88*	72	28	51.5	1,078.55
△ 18	38	16	39.78	1,656.54	△ 86	28	39	36.14	646.30
△ 15	47	03	29.37	1,957.55	△ 89R	57	29	57.34	1,136.50
△ 17	94	39	50.85	2,665.23	△ 88	93	50	26.52	1,344.52

TABLE NO. 3.—*Tertiary triangulations, St. Marys River, etc.*—Continued.

Stations.	Adjusted angles.			Sides.
	°	′	″	*Meters.*
△ 88	83	21	41.60	1,191.86
△ 114	32	35	23.33	646.30
△ 89R	64	02	55.07	1,078.92
△ 89R	31	48	44.90	688.50
△ 107	65	51	27.62	1,191.86
△ 114	82	19	47.48	1,294.42
△ 114	78	30	58.85	983.56
△ 112	43	18	50.24	688.50
△ 107	58	10	10.91	852.72
△ 107	45	52	11.33	785.42
△ 105	64	00	17.64	983.56
△ 112	70	07	31.03	1,029.09
△ 112	66	09	06.85	832.07
△ 110	59	41	37.06	785.42
△ 105	54	09	16.09	737.44
△ 105	44	45	01.09	625.68
△ 103	69	25	51.37	832.07
△ 110	65	49	07.54	810.75
△ 110	66	08	58.25	847.15
△ 108	42	29	36.02	625.68
△ 103	71	21	25.73	877.64
△ 103	61	25	15.79	997.10
△ 101	48	15	10.84	847.15
△ 108	70	19	33.37	1,069.16
△ 108	03	19	23.03	1,297.40
△ 106	48	24	17.35	997.10
△ 101	28	16	19.62	631.52
△ 101	119	56	55.63	2,296.43
△ 99	29	18	33.82	1,297.40
△ 106	30	44	30.55	1,354.77
△ 99	118	22	29.29	3,367.70
◬ Winter Point	36	52	05.16	2,296.43
△ 106	24	45	25.55	1,602.87
△ 106	45	04	35.74	3,969.35
△ 102	36	55	19.59	3,367.70
◬ Winter Point	98	00	04.67	5,551.44
△ 102	67	08	54.05	4,704.61
◬ Rocky Point	51	01	34.11	3,969.35
◬ Winter Point	61	49	31.84	4,500.75
△ 106*	113	44	08.00	6,479.66
△ 104*	28	24	34.40	3,367.70
◬ Winter Point*	37	51	17.60	4,342.76
Lake George:				
△ 16	120	18	56.21	1,127.88
△ 18	25	37	02.62	564.90
△ 25	34	04	01.17	731.87
△ 25	31	25	38.28	738.83
△ 27	52	44	54.09	1,127.88
△ 18	95	49	27.63	1,409.65
△ 18	90	08	24.22	1,244.87
△ 20	36	24	19.62	738.83
△ 27	53	27	16.16	1,000.11
△ 27	33	27	45.99	768.34
△ 29	63	18	02.08	1,244.87
△ 20	83	14	11.93	1,383.74
△ 20	75	11	35.82	1,125.05
△ 22	41	19	10.82	768.34
△ 29	63	29	13.36	1,041.30
△ 29	98	42	22.99	995.29
△ 31	49	44	11.48	768.34
△ 20	31	33	25.53	526.95

Stations.	Adjusted angles.			Sides.
Lake George—Cont'd.	°	′	″	*Meters.*
△ 29	33	53	37.58	820.27
△ 33	49	53	36.98	1,125.05
△ 22	96	12	45.44	1,462.30
△ 22	36	16	13.01	995.22
△ 24	29	10	58.42	820.27
△ 33	114	32	48.57	1,530.23
△ 33	35	00	48.48	574.58
△ 35	96	22	34.58	995.22
△ 24	48	36	36.94	751.30
△ 35	75	36	01.58	1,425.18
△ 37	22	59	08.48	574.58
△ 24	81	24	49.94	1,454.01
△ 24	38	26	12.82	886.28
△ 26	88	27	57.82	1,425.18
△ 37	53	05	49.36	1,140.05
△ 26	68	01	29.21	1,279.38
△ 28	39	58	18.62	886.28
△ 37	72	00	12.17	1,312.12
△ 37	41	45	36.38	901.16
△ 39	108	59	45.78	1,279.38
△ 28	29	14	37.84	661.01
△ 39	59	43	28.78	1,576.33
△ 30	29	35	05.78	901.16
△ 28	90	41	25.44	1,825.14
△ 28	46	04	56.18	1,204.52
△ 41	70	30	31.68	1,576.33
△ 30	63	24	32.14	1,495.29
△ 30	105	17	33.42	1,938.73
△ 32	36	49	09.01	1,204.52
△ 41	37	53	17.57	1,234.32
△ 32	64	06	55.82	2,158.23
△ 34	53	55	04.32	1,938.73
△ 41	61	57	59.86	2,117.44
△ 41	43	08	45.68	1,626.60
△ 43	65	08	13.18	2,158.10
△ 34	71	43	01.14	2,258.48
△ 43	51	26	48.38	2,146.07
△ 45	36	21	04.38	1,626.60
△ 34	92	12	07.24	2,742.21
△ 34	48	50	08.82	3,167.29
△ 40	30	40	12.42	2,146.07
△ 45	100	29	38.76	4,136.83
△ 40*	56	53	15.6	2,668.03
△ 38*	83	54	03.7	3,167.29
△ 45*	39	12	40.7	2,013.70
△ 45*	77	27	14.4	2,778.74
△ 36*	69	35	31.2	2,668.03
△ 38*	32	57	14.4	1,548.51
△ 45	45	28	31.48	3,101.54
△ 42	46	43	27.48	3,167.29
△ 40	87	48	01.04	4,347.09
△ 40	70	01	42.48	4,294.45
△ 47	42	44	56.58	3,101.54
△ 42	67	13	20.94	4,212.91
△ 42	81	29	06.11	5,330.30
△ 44	52	49	27.22	4,294.45
△ 47	45	41	26.67	3,856.77
△ 44	38	50	24.09	6,682.68
△ 46	52	52	14.38	5,330.30
△ 47	88	17	21.53	4,192.90

* Not in chain.

TABLE NO. 3.—*Tertiary triangulations, St. Marys River, etc.*—Continued.

Stations.	Adjusted angles.			Sides.	Stations.	Adjusted angles.			Sides.
Lake George—Cont'd.	°	′	″	*Meters.*	Little Mud Lake—Con.	°	′	″	*Meters.*
△ 44	41	38	50.89	4,390.74	△ 63½	96	22	07.01	974.34
△ 49	39	23	25.48	4,192.90	△ 65	51	26	50.41	766.70
△ 46	98	57	43.63	6,526.48	△ 66	32	11	02.58	522.19
△ 46	79	50	41.41	8,032.25	△ 66*	18	09	37.8	521.41
△ 48	32	33	09.62	4,390.74	△ 68*	35	37	17 4	974.34
△ 49	67	36	08.97	7,544.50	△ 65*	126	13	04.8	1,349.65
△ 49	40	35	14.28	5,230.33	△ 65	81	09	56.61	1,460.88
△ 31	92	22	47.29	8,032.25	△ 70	41	13	35.61	974.34
△ 48	47	01	58.43	5,882.64	△ 66	57	36	27.78	1,248.38
△ 51	28	18	51.39	2,682.65	△ 65*	83	38	52.4	1,813.22
△ 53	67	37	51.68	5,230.33	△ 72*	43	10	39.9	1,248.38
△ 48	84	03	16.93	5,625.51	△ 70*	53	10	27.7	1,460.38
△ 48	56	29	36.02	2,490.62	△ 70*	33	34	11.2	1,023.75
△ 50	63	54	38.32	2,682.65	△ 91*	78	20	26.3	1,813.22
△ 53	59	35	45.66	2,576.21	△ 72*	68	05	22.5	1,717.69
△ 53	47	11	53.68	2,949.77	△ 91*	61	53	46.2	1,292.69
△ 54	38	16	47.68	2,490.62	△ 93*	44	18	45.5	1,023.75
△ 50	94	31	18.64	4,007.84	△ 72*	73	47	28.3	1,407.23
△ 50	38	15	33.02	1,851.97	△ 91*	47	17	29.2	1,109.29
△ 52	99	30	09.42	2,949.77	△ 74*	68	46	36.4	1,407.23
△ 54	42	14	17.56	2,010.46	△ 93*	63	55	54.4	1,356.04
△ 52	60	19	25.02	2,851.46	△ 70	94	24	08.49	2,414.35
△ 56	34	21	11.22	1,851.97	△ 72	37	06	22.97	1,460.88
△ 54	85	19	23.76	3,271.00	△ 66	48	29	28.54	1,813.36
△ 54	42	19	10.18	2,118.05	△ 66	49	44	31.56	1,843.65
△ 55	65	00	40.58	2,851.40	△ 95	87	58	31.39	2,414.35
△ 56	72	40	09.24	3,003.12	△ 72	42	16	57.05	1,625.35
△ 56	35	55	08.32	1,693.00	△ 72	64	40	50.17	2,290.46
△ 58	47	12	59.02	2,118.05	△ 97	46	41	09.57	1,843.65
△ 55	96	51	52.66	2,865.24	△ 95	68	38	00.26	2,359.72
△ 55	65	05	35.18	1,768.15	△ 95	62	29	15.64	3,095.29
□ 59	60	16	42.78	1,693.00	△ 98	41	01	05.68	2,290.46
△ 58	54	37	42.04	1,589.62	△ 97	76	29	38.70	3,393.46
△ 58	57	38	34.19	2,131.06	△ 97	107	17	33.81	4,777.59
△ 59	44	29	50.49	1,768.15	△ Winter Point	38	12	47.64	3,095.29
□ 59	77	51	35.32	2,466.36	△ 98	34	29	38.57	2,833.72
Little Mud Lake:					△ 98	50	15	10.12	4,704.61
□ 59	28	53	44.29	1,208.00	△ Rocky Point	51	20	49.24	4,777.59
△ 60	58	28	44.40	2,131.06	△ Winter Point	78	24	00.69	5,992.79
△ 59	92	37	31.31	2,497.30					
					Middle Neebish:				
△ 60	70	09	01.59	2,288.21	△ 55	46	11	14.63	1,147.45
△ 61	29	46	21.59	1,208.00	□ 36	91	27	15.43	1,589.62
△ 59	80	04	36.82	2,396.35	□ 59	42	21	29.94	1,071.38
△ 59	20	17	30.99	835.30	□ 36	47	55	03.77	1,024.61
△ 62	71	48	44.29	2,288.51	□ 51	56	12	57.17	1,147.45
△ 61	87	53	44.72	2,406.90	□ 59	75	51	59.06	1,338.75
△ 62	74	04	26.59	1,236.79	□ 51	85	29	12.85	1,758.15
△ 63	40	30	01.00	835.30	△ 57	35	31	33.37	1,024.61
△ 61	65	25	32.41	1,169.67	□ 59	58	59	13.76	1,511.5'
△ 61	39	54	14.79	806.56	□ 59	37	15	55.47	1,065.76
△ 64	79	38	23.19	1,236.79	□ 53	87	18	19.27	1,758.15
△ 63	60	27	22.02	1,093.82	△ 57	55	25	45.26	1,449.31
△ 64	65	34	04.49	926.28	□ 53	33	29	09.87	1,206.12
△ 66	52	26	44.20	806.56	□ 55	29	04	46.37	1,065.76
△ 63	61	59	11.31	898.19	△ 57	17	33	03.76	1,944.14
△ 63	55	28	25.11	766.70	△ 57	32	33	15.93	822.86
△ 63½	84	28	00.61	926.28	△ 67	52	03	52.93	1,206.12
△ 66	40	03	34.28	598.92	□ 55	95	22	51.14	1,522.50

* Not in chain.

TABLE No. 3.—*Tertiary triangulations, St. Marys River, etc.*—Continued.

Stations.	Adjusted angles.			Sides.
Middle Neebish—Con.	°	′	″	*Meters.*
□ 55	73	56	26.57	1,010.04
△ 71	51	31	38.57	822.86
△ 67	54	31	54.86	856.02
△ 71	65	46	09.87	1,424.32
△ 69	40	17	25.87	1,010.04
△ 67	73	56	24.26	1,500.97
△ 67	58	11	07.27	1,832.22
△ 73	41	20	38.67	1,424.32
△ 69	80	28	14.06	2,126.41
△ 36	43	32	10.6	927.82
△ 55	83	45	27.2	1,338.75
□ 51	52	42	22.2	1,071.38
△ 69	82	12	53.53	3,800.69
△ 76	28	32	00.93	1,832.22
△ 73	69	15	05.54	3,586.98
St. Marys River, near Sault Ste. Marie:				
△ 8	43	20	14.5	1,909.91
△ 13	105	36	38.6	2,680.28
△ 14	31	03	06.9	1,435.48
△ 6	20	25	18.5	1,300.55
□ 9	139	19	29.9	2,429.30
△ 8	20	15	11.6	1,290.26
△ 9	69	37	49.0	1,770.76
□ 11	67	14	17.0	1,741.77
△ 6	43	07	34.0	1,291.38
△ 14	74	27	45.2	1,638.25
□ 4	51	26	37.9	1,329.70
△ 21	54	05	36.9	1,377.27
Lake George, triangles not in chain:				
△ 16	18	54	00.0	322.13
□ 17	47	23	07.5	731.87
△ 18	113	42	52.5	910.52
△ 41	40	29	33.7	1,417.14
□ 19	98	31	55.6	2,158.23
△ 34	40	58	30.7	1,431.06
□ 19	47	44	01.0	1,064.75
□ 21	80	02	36.0	1,417.14
△ 34	52	13	23.0	1,137.23
□ 21	83	18	24.0	1,482.00
□ 23	45	31	31.0	1,064.75
△ 34	51	10	05.0	1,162.38
△ 32	82	06	26.0	2,933.41
□ 6	45	38	35.0	2,117.44
△ 34	52	14	59.0	2,341.59
△ 43	18	03	09.6	862.64
□ 8	99	54	06.7	2,742.21
△ 45	62	02	43.7	2,458.88
△ 45	54	07	00.0	703.52
□ 25	83	26	33.0	862.64
□ 8	42	26	27.0	585.97
△ 45	64	47	20.4	4,048.46
□ 10	103	42	56.3	4,347.09
△ 42	11	29	43.3	891.76
△ 45	40	25	25.8	3,389.56
□ 12	123	44	05.8	4,347.09
△ 42	15	50	28.4	1,426.91
△ 40	61	22	47.0	2,726.18
□ 14	87	03	08.5	3,101.54
△ 42	31	34	04.5	1,625.84

Stations.	Adjusted angles.			Sides.
Lake George, triangles not in chain—Cont'd.	°	′	″	*Meters.*
△ 40	54	10	28.8	2,570.12
□ 27	78	05	03.4	3,101.54
△ 42	47	44	27.8	2,346.04
□ 34	83	48	59.6	2,118.05
△ 55	66	28	54.8	1,953.48
△ 56	29	42	05.6	1,035.60
□ 32	28	14	06.5	1,035.60
□ 34	32	26	56.1	1,197.18
△ 55	119	18	57.4	1,945.53
△ 34R	70	30	06.38	2,258.48
△ 43	63	43	07.37	2,148.22
△ 41	45	46	46.25	1,717.04
□ 10R	104	39	05.86	4,347.09
△ 42	11	55	10.69	928.02
△ 45	63	25	43.45	4,018.63
□ 12R	126	11	07.81	4,347.09
△ 42	16	39	46.49	1,544.38
△ 45	37	09	05.70	3,252.74
△ 42½	55	13	31.85	3,856.76
△ 44	93	06	19.30	4,688.44
△ 42	31	40	08.85	2,465.11
△ 46R	52	49	22.47	5,330.30
△ 47	38	44	06.22	4,185.99
△ 44	88	26	31.31	6,687.40
△ 40	42	03	04.6	2,078.98
□ 16	87	45	49.7	3,101.54
△ 42	50	11	05.7	2,384.16
△ 40	43	29	02.7	2,216.89
□ 18	74	18	52.6	3,101.54
△ 42	62	12	04.7	2,849.72
Light-house, Lake George	30	25	04.25	1,700.99
□ 35	96	40	51.50	3,336.83
△ 51	52	54	04.25	2,679.64
Crib Light, foot of flats	20	08	07.50	1,700.99
□ 35	120	08	43.25	4,273.01
△ 51	39	43	09.25	3,157.63
Shoal Island Light	18	29	26.0	1,197.18
△ 55	104	09	04.5	3,660.29
□ 32	57	21	29.5	3,178.64
△ 40	37	22	58.9	2,008.75
□ 20	69	37	30.3	3,101.54
△ 42	72	59	30.8	3,163.84
△ 40	40	40	59.2	2,283.10
□ 29	62	19	13.6	3,101.54
△ 42	76	59	47.2	3,412.54
△ 40	33	56	00.3	2,120.48
□ 22	54	44	09.4	3,101.54
△ 42	91	19	50.3	3,797.56
△ 49	87	17	38.5	6,059.15
□ 31	46	22	20.3	4,390.74
△ 46	46	20	01.2	4,387.92
△ 48	17	21	02.4	1,582.84
□ 33	80	12	30.2	5,230.33
△ 51	82	26	27.4	5,261.53
□ 33	100	22	31.9	2,026.02
□ 31½	50	13	04.2	1,582.84
△ 51	29	24	23.9	1,011.32

TABLE NO. 3.—*Tertiary triangulations, St. Marys River, etc.*—Continued.

Stations.	Adjusted angles.			Sides.	Stations.	Adjusted angles.			Sides.
	°	′	″	*Meters.*		°	′	″	*Meters.*
Crib E (1881)	98	38	39.1	2,809.39	△ 48	62	57	17.0	2,344.98
Crib W (1881)	43	04	02.8	1,940.53	□ 37	78	05	21.5	2,576.21
△ 48	38	17	18.1	1,760.82	△ 50	38	57	21.5	1,655.36
△ 48	62	57	17.0	2,344.98	□ 37	27	12	38.0	765.68
□ 37	78	05	21.5	2,576.21	□ 24	98	40	07.5	1,655.36
△ 50	38	57	21.5	1,655.36	△ 48	54	07	14.5	1,356.76
△ 49R	39	18	19.52	4,185.99	□ 37	51	09	56.3	1,905.72
△ 44	41	50	46.26	4,408.55	□ 39	106	33	42.3	2,344.98
△ 46R	98	50	54.22	6,529.55	△ 50	22	16	21.4	927.25
Manchester Crib Light	138	17	45.0	3,252.74	△ 53	89	11	40.0	3,181.14
□ 12R	30	23	14.0	2,473.86	□ 26	57	28	52.0	2,682.65
△ 42	11	19	01.0	959.45	△ 48	33	19	28.0	1,747.82
Church's Crib Light	82	22	00.0	3,856.76	△ 48	45	11	51.6	1,905.70
△ 42	45	10	02.5	2,759.55	□ 39	73	34	31.2	2,576.21
△ 44	52	27	57.5	3,085.02	△ 50	61	13	37.2	2,354.21
Crib Light at head of flats	53	20	41.0	4,408.55	△ 52	18	19	35.7	769.80
△ 49R	83	36	58.5	5,464.67	□ 43	49	09	10.6	1,851.97
△ 46R	42	42	20.5	3,727.08	△ 54	112	31	13.7	2,261.52
Light-house, Lake George				23,775.59	□ 43	74	47	19.4	929.16
◬ Laird	47	29	59.88	19,084.19	□ 28	53	04	44.3	769.80
◬ Rankin Mountain	19	12	37.63	8,517.11	△ 54	52	07	56.3	760.14
△ 34	52	14	59.0	2,341.59	□ 43	66	50	12.6	922.87
□ 6	45	38	35.0	2,117.44	□ 41	49	13	25.7	760.14
△ 32	82	06	26.0	2,933.41	□ 28	63	56	21.7	901.73
Crib E (1879)	98	30	06.6	2,807.70	□ 43	57	02	31.0	743.26
Crib W (1879)	43	10	19.3	1,942.35	□ 45	60	20	43.0	769.80
△ 48	38	19	34.1	1,760.51	△ 54	62	36	46.0	786.54
△ 48	91	11	02.7	3,923.32	□ 45	43	29	49.9	555.43
Crib W (1882)	43	07	38.6	2,682.65	□ A (1881)	77	05	17.7	786.54
△ 53	45	41	18.7	2,807.95	□ 43	59	24	52.4	694.67
△ 53	45	39	59.4	2,809.39	□ 45	77	27	28.7	834.30
Crib W (1881)	43	04	47.4	2,682.65	□ B (1881)	66	57	47.5	786.54
△ 48	91	15	13.2	3,926.70	□ 43	35	34	43.8	497.28
△ 53	45	38	38.7	2,807.70	△ 54	46	48	53.7	954.80
Crib W (1879)	43	05	28.9	2,682.65	□ 47	34	35	00.7	743.26
△ 48	91	15	52.4	3,925.84	□ 45	98	36	05.6	1,294.74
□ 33	51	46	38.5	4,147.36	△ 57	50	37	30.6	783.39
□ 35	94	40	54.5	5,261.53	□ C (1883)	88	52	46.3	1,206.12
△ 48	33	32	27.0	2,916.89	□ 55	40	29	43.1	932.52

TABLE No. 4.—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, between Little Rapids and Rocky Point.*

Station.	Latitude.	Longitude.	Azimuth.	To stations—	Distance.	Logarithms of distances.	Distance
Hay Lake:	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
△ East base Soo.	46 29 14.06	84 18 14.04	.....	.....	.....	.....	.....
△ 21	46 29 21.39	84 18 35.78	237 29 52.0	△ 14	1,329.70	3.1237525	0.826
			183 24 15.1	□ 4	1,638.25	3.2143792	1.018
△ 14 (Top Sail Island).	46 29 44.52	84 17 43.20	15 05 31.6	△ 1	1,458.58	3.1639292	0.906
			311 45 29.3	△ 4U	1,282.12	3.1079289	0.797
			131 58 15.4	□ 4	1,377.27	3.1390196	0.856
			57 30 30.2	△ 21	1,329.70	3.1237525	0.826
			352 34 28.2	△ 23	1,270.38	3.1039341	0.789
			290 00 04.5	△ 25	1,425.11	3.1538491	0.885
			268 08 41.2	△ 16	1,516.63	3.1808807	0.942
			84 59 56.4	□ 13	1,909.91	3.2810128	1.187
△ 4U	46 29 16.87	84 16 58.36	131 46 01.8	△ 14	1,282.12	3.1079289	0.797
			211 47 19.3	△ 16	1,062.22	3.0262138	0.660
			67 28 31.4	△ 1	1,446.63	3.1603571	0.899
			8 01 08.4	△ 6	1,432.76	3.1561737	0.890
△ 1	46 28 58.91	84 18 01.00	247 27 46.0	△ 4U	1,446.63	3.1603571	0.899
			195 05 18.8	△ 14	1,458.58	3.1639292	0.906
			307 15 05.6	△ 6	1,427.96	3.1546989	0.887
			347 02 33.2	△ 3	1,578.84	3.1983374	0.981
△ 6	46 28 30.92	84 17 07.73	127 15 44.2	△ 1	1,427.90	3.1546989	0.887
			188 01 01.6	△ 4U	1,432.76	3.1561737	0.890
			49 15 40.2	△ 3	1,033.00	3.0141013	0.642
			322 02 29.0	△ 8	1,195.42	3.0775197	0.743
			3 45 05.0	△ 5	1,474.33	3.1685936	0.916
△ 3	46 28 09.08	84 17 44.40	167 02 45.2	△ 1	1,578.84	3.1983374	0.981
			229 15 13.6	△ 6	1,033.00	3.0141013	0.642
			280 01 07.8	△ 8	1,541.54	3.1879539	0.958
△ 8	46 28 00.39	84 16 33.27	100 01 59.4	△ 3	1,541.54	3.1879539	0.958
			142 02 54.0	△ 6	1,195.42	3.0775197	0.743
			57 34 06.5	△ 5	985.52	2.9936678	0.612
			8 14 43.8	△ 7	1,250.50	3.0970831	0.777
			320 42 05.3	△ 10	1,311.22	3.1176752	0.815
△ 5	46 27 43.27	84 17 12.24	183 45 01.7	△ 6	1,474.33	3.1685936	0.916
			237 33 38.2	△ 8	985.52	2.9936678	0.612
			317 22 16.0	△ 7	963.57	2.9838854	0.599
△ 7	46 27 20.31	84 16 41.67	137 22 38.2	△ 5	963.57	2.9838854	0.599
			188 14 37.7	△ 8	1,250.50	3.0970831	0.777
			257 33 08.3	△ 10	1,034.12	3.0145715	0.643
			336 54 11.8	△ 9	1,240.19	3.0934887	0.771
△ 10	46 27 27.53	84 15 54.36	77 33 42.6	△ 7	1,034.12	3.0145715	0.643
			140 42 33.5	△ 8	1,311.22	3.1176752	0.815
			21 00 13.6	△ 9	1,460.64	3.1645434	0.908
			312 55 49.1	△ 12	2,350.66	3.3711899	1.461
			358 53 24.4	△ 11	2,055.47	3.3129118	1.277
△ 9	46 26 43.37	84 16 18.88	156 54 28.2	△ 7	1,240.19	3.0934887	0.771
			200 59 55.8	△ 10	1,460.64	3.1645434	0.908
			276 02 03.4	△ 12	2,257.18	3.3535660	1.403
△ 12	46 26 35.67	84 14 33.74	96 03 19.6	△ 9	2,257.18	3.3535660	1.403
			132 56 47.5	△ 10	2,350.66	3.3711899	1.461
			74 54 15.4	△ 11	1,741.52	3.2409282	1.082
			347 20 30.9	△ 14	1,049.51	3.0209853	0.652
△ 11	46 26 20.97	84 15 52.49	344 52 38.7	△ 13	2,334.64	3.3682202	1.451
			178 53 25.7	△ 10	2,055.47	2.3129118	1.277
			254 53 18.3	△ 12	1,741.52	3.2409282	1.082
			286 35 59.9	△ 14	1,994.83	3.2999049	1.240
△ 14	46 26 02.51	84 14 22.97	106 37 04.8	△ 11	1,994.83	3.2999049	1.240
			167 20 38.8	△ 12	1,049.51	3.0209853	0.652
			37 44 33.8	△ 13	2,128.92	3.3281586	1.323
			344 42 43.9	△ 16	2,582.70	3.4120744	1.605
△ 13	46 25 07.98	84 15 23.97	164 52 59.4	△ 11	2,334.64	3.3682202	1.451
			217 43 49.6	△ 14	2,128.92	3.3281586	1.323
			292 08 29.6	△ 16	2,142.28	3.3308760	1.331
			354 39 45.5	△ 15	1,469.81	3.1672615	0.913

TABLE NO. 4.—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, etc.*—Continued.

Station.	Latitude.	Longitude.	Azimuth.	To stations—	Distance.	Logarithms of distances.	Distance.
Hay Lake—Continued.	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
△ 15	46 24 20.59	84 15 17.56	174 39 50.1	△ 13	1,469.81	3.1672615	0.913
			250 27 11.1	△ 16	1,960.58	3.2923852	1.218
			298 39 42.1	△ 18	2,665.23	3.4257349	1.656
			345 43 11.4	△ 17	1,656.54	3.2192013	1.029
△ 16	46 24 41.83	84 13 51.08	112 09 36.9	△ 13	2,142.28	3.3308760	1.331
			164 43 07.0	△ 14	2,582.70	3.4120744	1.605
			70 28 13.7	△ 15	1,960.58	3.2923852	1.218
			345 46 20.9	△ 18	1,995.66	3.3000874	1.240
△ 18	46 23 39.18	84 13 28.12	118 41 01.3	△ 15	2,665.23	3.4257349	1.656
			165 46 37.5	△ 16	1,995.66	3.3000874	1.240
			80 24 21.5	△ 17	1,957.55	3.2917125	1.216
			12 34 25.2	△ 19	3,046.00	3.4837299	1.893
			312 35 44.6	△ 20	2,343.05	3.3697824	1.456
△ 17	46 23 28.60	84 14 58.44	165 43 25.3	△ 15	1,656.54	3.2192013	1.029
			260 23 16.1	△ 18	1,957.55	3.2917125	1.216
			334 23 58.3	△ 19	2,934.37	3.4675142	1.823
△ 19	46 22 02.89	84 13 59.12	154 24 41.2	△ 17	2,934.37	3.4675142	1.823
			192 34 02.7	△ 18	3,046.00	3.4837299	1.893
			239 50 31.1	△ 20	2,761.60	3.4411601	1.716
			276 05 08.6	△ 75	3,737.36	3.5725651	2.322
			332 20 48.1	△ 21	2,075.58	3.3171392	1.290
△ 20	46 22 47.82	84 12 07.37	132 36 43.1	△ 18	2,343.05	3.3697824	1.456
			59 51 52.0	△ 19	2,761.60	3.4411601	1.716
			323 20 32.2	△ 75	2,224.04	3.3471356	1.382
△ 75	46 21 50.04	84 11 05.26	96 07 14.4	△ 19	3,737.36	3.5725651	2.322
			143 21 17.1	△ 20	2,224.00	3.3471356	1.382
			62 23 06.6	△ 21	3,107.90	3.4924672	1.931
			341 38 51.9	△ 73	2,685.29	3.4289916	1.669
			48 21 22.9	△ 76	3,953.17	3.5969452	2.456
△ 21	46 21 03.35	84 13 14.02	152 21 20.7	△ 19	2,075.58	3.3171392	1.290
			242 21 33.4	△ 75	3,107.90	3.4924672	1.931
			287 05 09.6	△ 73	3,766.06	3.5758876	2.340
			9 34 08.2	△ 76	1,203.15	3.0803204	0.748
△ 73	46 20 27.49	84 10 25.73	107 07 11.4	△ 21	3,766.06	3.5758876	2.340
			161 39 20.5	△ 75	2,685.29	3.4289916	1.669
			88 49 44.3	△ 76	3,800.69	3.5798627	1.876
			30 48 37.8	△ 77	2,389.43	3.3782939	1.485
			19 34 38.7	△ 69	1,832.22	3.2629788	1.139
			338 13 59.8	△ 67	2,126.41	3.3276481	1.321
△ 76	46 20 24.93	84 13 23.36	189 34 01.5	△ 21	1,203.15	3.0803204	0.748
			268 47 35.8	△ 73	3,800.69	3.5798627	1.876
			307 26 15.8	△ 77	3,245.48	3.5112783	2.017
			354 08 07.4	△ 78	2,435.53	3.3865927	1.513
			297 19 36.6	△ 69	3,586.98	3.5547286	2.229
			228 19 54.2	△ 75	3,953.17	3.5969452	2.456
West Neebish:							
△ 77	46 19 21.02	84 11 22.92	127 27 42.9	△ 76	3,245.48	3.5112783	2.017
			210 47 56.4	△ 73	2,389.43	3.3782939	1.485
			79 05 10.9	△ 78	2,371.12	3.3749533	1.473
			46 12 54.6	△ 79	1,802.31	3.2558300	1.120
△ 78	46 19 06.47	84 13 11.72	174 08 15.8	△ 76	2,435.53	3.3865927	1.513
			259 03 52.2	△ 77	2,371.12	3.3749533	1.473
			307 49 51.6	△ 79	1,300.76	3.1141968	0.808
			0 21 52.4	△ 80	2,585.25	3.4125017	1.606
△ 79	46 18 40.62	84 12 23.71	127 50 26.3	△ 78	1,300.76	3.1141968	0.808
			226 12 10.6	△ 77	1.802.31	3.2558300	1.120
			30 17 38.6	△ 80	2,069.86	3.3159416	1.286
			6 38 14.6	△ 81	2,044.01	3.3104811	1.270
△ 80	46 17 42.74	84 13 12.48	210 17 03.3	△ 79	2,069.86	3.3159416	1.286
			180 21 51.8	△ 78	2,585.25	3.4125017	1.606
			286 44 11.2	△ 81	843.64	2.9261558	0.524
			335 09 45.4	△ 82	1,189.91	3.0755154	0.739
			307 39 00.1	△ 83	1,139.18	3.0565923	0.708
△ 81	46 17 34.87	84 12 34.75	106 44 38.5	△ 80	843.64	2.9261558	0.524
			186 38 06.6	△ 79	2,044.01	3.3104811	1.270
			20 13 03.1	△ 82	891.82	2.9502750	0.554

TABLE NO. 4.—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, etc.*—Continued.

Station.	Latitude.	Longitude.	Azimuth.	To stations—	Distance.	Logarithms of distances.	Distance.
West Neebish--Continued.	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
△ 82	46 17 07.76	84 12 49.13	200 12 52.7	△ 81	891.82	2.9502750	0.554
			155 10 02.3	△ 80	1,189.91	3.0755154	0.739
			226 19 33.8	△ 83	556.03	2.7450979	0.346
			283 55 37.3	△ 85	722.11	2.8586018	0.494
△ 83	46 17 20.20	84 12 30.36	46 19 47.4	△ 82	556.03	2.7450979	0.346
			127 39 30.6	△ 80	1,139.18	3.0565923	0.708
			331 49 57.3	△ 85	632.72	2.8012133	0.393
			1 46 46.4	△ 84	640.70	2.8066583	0.398
△ 85	46 17 02.13	84 12 16.41	151 50 07.4	△ 83	632.72	2.8012133	0.393
			103 56 01.0	△ 82	722.11	2.8586018	0.449
			75 27 57.8	△ 84	329.11	2.5173383	0.204
			355 51 32.6	△ 86	572.46	2.7577483	0.356
			312 27 00.6	△ 87	669.52	2.8257641	0.416
△ 84	46 16 59.46	84 12 31.28	255 27 47.0	△ 85	229.11	2.5173383	0.204
			181 46 45.7	△ 83	640.70	2.8066583	0.398
			323 36 30.0	△ 86	606.67	2.7829537	0.377
△ 86	46 16 43.64	84 12 14.48	175 51 34.0	△ 85	572.46	2.7577483	0.356
			143 36 42.2	△ 84	606.67	2.7829537	0.376
			255 15 45.2	△ 87	468.08	2.6703175	0.291
			328 28 40.7	△ 88	1,136.50	3.0555685	0.706
			299 49 04.6	△ 89 R	1,344.52	3.1285665	0.835
△ 87	46 16 47.49	84 11 53.34	75 16 00.5	△ 86	468.08	2.6703175	0.291
			132 27 17.3	△ 85	669.52	2.8257641	0.416
			352 35 33.6	△ 88	1,097.04	3.0402207	0.682
			320 59 38.0	△ 89	1,078.55	3.0328414	0.670
△ 88	46 16 12.26	84 11 46.74	172 35 38.2	△ 87	1,097.04	3.0402207	0.682
			148 29 00.7	△ 86	1,136.50	3.0555685	0.706
			242 19 27.2	△ 89 R	646.30	2.8104323	0.402
			325 41 08.8	△ 114	1,078.92	3.0329884	0.670
			245 04 29.8	△ 89	592.62	2.7727766	0.368
△ 89	46 16 20.35	84 11 21.64	65 04 47.9	△ 88	592.62	2.7727766	0.368
			141 00 01.0	△ 87	1,078.55	3.0328414	0.670
△ 89 R	46 16 21.98	84 11 20.01	62 19 46.5	△ 88	646.30	2.8104323	0.402
			119 49 43.9	△ 86	1,344.52	3.1285665	0.835
			358 16 51.5	△ 114	1,191.86	3.0762272	0.741
			326 28 06.6	△ 107	1,294.42	3.1120758	0.804
△ 114	46 15 43.40	84 11 18.34	145 41 29.3	△ 88	1,078.92	3.0329884	0.670
			178 16 52.7	△ 89 R	1,191.86	3.0762272	0.741
			260 36 40.2	△ 107	688.50	2.8379054	0.428
			339 07 39.0	△ 112	852.72	2.9308053	0.530
△ 107	46 15 47.03	84 10 46.64	80 37 03.1	△ 114	688.50	2.8379954	0.428
			146 28 30.7	△ 89 R	1,294.42	3.1120758	0.804
			22 26 52.2	△ 112	983.56	2.9928018	0.611
			336 34 40.8	△ 105	1,029.09	3.0124540	0.639
△ 112	46 15 17.59	84 11 04.16	159 07 49.2	△ 114	852.72	2.9308053	0.530
			202 26 39.5	△ 107	983.56	2.9928018	0.611
			272 34 10.5	△ 105	785.42	2.8951025	0.488
			338 43 17.4	△ 110	737.44	2.8677266	0.458
△ 105	46 15 16.45	84 10 27.54	156 34 54.6	△ 107	1,029.09	3.0124540	0.639
			92 34 37.0	△ 112	785.42	2.8951025	0.488
			38 25 20.9	△ 110	832.07	2.9201618	0.517
			353 40 19.8	△ 103	810.75	2.9088860	0.504
△ 110	46 14 55.33	84 10 51.67	158 43 26.4	△ 112	737.44	2.8677266	0.458
			218 25 03.4	△ 105	832.07	2.9201618	0.517
			284 14 11.0	△ 103	625.68	2.7963542	0.389
			350 23 09.2	△ 108	877.64	2.9433188	0.545
△ 103	46 14 50.35	84 10 23.37	104 14 31.4	△ 110	625.68	2.7963542	0.389
			173 40 22.8	△ 105	810.75	2.9088860	0.504
			32 53 05.7	△ 108	847.15	2.9279588	0.526
			331 27 49.9	△ 101	1,069.16	3.0290435	0.664
△ 108	46 14 27.31	84 10 44.83	170 23 14.2	△ 110	877.64	2.9433188	0.545
			212 52 50.2	△ 103	847.15	2.9279588	0.526
			283 12 23.6	△ 101	997.10	2.9987393	0.620
			26 31 46.6	△ 106	631.52	2.8003883	0.392

TABLE NO. 4.—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, etc.*—Continued.

Station.	Latitude.	Longitude.	Azimuth.	To stations—	Distance.	Logarithms of distances.	Distance.
West Neebish—Continued.	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
△ 101	46 14 19.93	84 09 59.54	103 12 56.3	△ 108	997.10	2.9987393	0.620
			151 28 07.1	△ 103	1,069.16	3.0290435	0.664
			74 56 36.7	△ 106	1,297.40	3.1130737	0.806
			314 59 41.0	△ 99	1,354.77	3.1318648	0.842
△ 106	46 14 09.00	84 10 57.99	206 31 37.1	△ 108	631.52	2.8003883	0.392
			254 55 54.4	△ 101	1,297.40	3.1130737	0.806
			285 40 25.0	△ 99	2,296.43	3.3610533	1.427
			310 25 50.5	◬ Winter Pt.	3,367.70	3.5273329	2.093
			355 30 26.3	△ 102	5,551.44	3.7444055	3.450
			64 09 58.5	△ 104	4,342.76	3.6378655	2.699
△ 99	46 13 48.90	84 09 13.84	105 41 39.5	△ 106	2,296.43	3.3610533	1.427
			134 00 13.3	△ 101	1,354.77	3.1318648	0.842
			347 19 10.2	◬ Winter Pt.	1,602.87	3.2048989	0.996
◬ Winter Pt.	46 12 58.23	84 08 58.45	214 00 52.2	△ 97	2,833.72	3.4523575	1.761
			130 27 16.9	△ 106	3,367.70	3.5273329	2.093
			167 19 22.1	△ 99	1,602.87	3.2048989	0.996
			32 27 12.2	△ 102	3,969.35	3.5987192	2.466
			330 37 40.4	◬ Rocky Pt.	4,704.61	3.6725236	2.922
			92 35 59.3	△ 104	6,479.65	3.8115521	4.026
			252 13 39.8	△ 98	4,777.59	3.6792093	2.969
△ 102	46 11 09.75	84 10 37.72	175 30 40.9	△ 106	5,551.44	3.7444055	3.450
			212 26 10.5	◬ Winter Pt.	3,969.35	3.5987192	2.466
			279 35 04.6	◬ Rocky Pt.	4,500.75	3.6532850	2.797
◬ Rocky Pt.	46 10 45.43	84 07 10.87	99 37 33.9	△ 102	4,500.75	3.6532850	2.797
			150 38 58.0	◬ Winter Pt.	4,704.61	3.6725256	2.922
			201 59 47.4	△ 98	5,992.79	3.7776289	3.724
△ 104	46 13 07.66	84 14 00.35	244 07 46.8	△ 106	4,342.76	3.6378655	2.699
			272 32 21.3	◬ Winter Pt.	6,479.66	3.8115521	4.026
Lake George:							
△ 23	46 29 03.72	84 17 35.50	172 34 33.8	△ 14	1,270.38	3.1039341	0.789
			236 41 08.2	△ 25	1,406.06	3.1480042	0.874
△ 25	46 29 28.73	84 16 40.40	110 00 50.1	△ 14	1,425.11	3.1538491	0.886
			56 41 48.1	△ 23	1,406.06	3.1480042	0.874
			198 14 20.4	△ 16	564.90	2.7519679	0.351
			232 18 19.9	△ 18	1,127.88	3.0522626	0.701
			263 43 58.2	△ 27	1,409.65	3.1491104	0.876
△ 16	46 29 46.11	84 16 32.11	88 09 32.8	△ 14	1,516.63	3.1808807	0.942
			18 14 26.4	△ 25	564.90	2.7519679	0.351
			31 47 38.3	△ 4 U	1,062.22	3.0262138	0.660
			257 55 28.6	△ 18	731.87	2.8644345	0.455
			276 49 28.6	□ 17	910.52	2.9592880	0.566
△ 18	46 29 51.07	84 15 58.55	77 55 52.9	△ 16	731.87	2.8644345	0.455
			52 18 50.3	△ 25	1,127.88	3.0522626	0.701
			316 29 22.7	△ 27	738.83	2.8685419	0.459
			72 10 37.9	△ 29	1,533.15	3.1855834	0.953
			226 20 58.4	△ 20	1,000.11	3.0000466	0.621
			324 13 00.4	□ 17	322.13	2.5080354	0.200
△ 27	46 29 33.71	84 15 34.70	83 44 45.9	△ 25	1,409.65	3.1491104	0.876
			136 29 40.0	△ 18	738.83	2.8685419	0.459
			189 56 56.1	△ 20	1,244.87	3.0951227	0.774
			223 24 42.1	△ 29	1,383.74	3.1410559	0.860
△ 20	46 30 13.42	84 15 24.61	46 21 23.1	△ 18	1,000.11	3.0000466	0.621
			9 57 03.4	△ 27	1,244.87	3.0951227	0.774
			286 42 51.5	△ 29	768.34	2.8855510	0.477
			211 31 15.7	△ 22	1,041.30	3.0175750	0.647
			255 09 26.0	△ 31	995.29	2.9979482	0.618
△ 29	46 30 06.27	84 14 50.10	43 25 14.5	△ 27	1,383.74	3.1410559	0.860
			106 43 16.6	△ 20	768.34	2.8855510	0.477
			170 12 29.9	△ 22	1,125.05	3.0511701	0.699
			205 25 39.5	△ 31	526.95	2.7217731	0.327
			204 06 07.5	△ 33	1,462.30	3.1650364	0.909
			72 11 01.9	△ 18	1,533.15	3.1855834	0.953
△ 22	46 30 42.17	84 14 59.08	31 31 34.2	△ 20	1,041.30	3.0175750	0.647
			350 12 23.4	△ 29	1,125.05	3.0511701	0.699
			253 59 38.0	△ 33	820.27	2.9139595	0.510
			217 43 25.0	△ 24	1,530.23	3.1847574	0.951

TABLE NO. 4.—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, etc.*—Continued.

Station.	Latitude.	Longitude.	Azimuth.	To stations—	Distance.	Logarithms of distances.	Distance.
Lake George—Continued.	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
△ 31	46 30 21.68	84 14 39.49	75 09 58.7	△ 20	995.29	2.9979482	0.618
			25 25 47.2	△ 29	526.95	2.7217731	0.327
△ 33	46 30 49.50	84 14 22.09	24 06 27.8	△ 29	1,462.30	3.1650364	0.909
			74 00 04.8	△ 22	820.27	2.9139595	0.510
			188 32 53.4	△ 24	995.22	2.9979211	0.618
			223 33 41.8	△ 35	751.30	2.8758107	0.467
△ 24	46 31 21.37	84 14 15.16	37 43 56.8	△ 22	1,530.23	3.1847574	0.951
			8 32 58.4	△ 33	995.22	2.9979211	0.618
			319 56 21.4	△ 35	574,58	2.7593524	0.357
			238 31 31.5	△ 37	1,425.18	3.1538688	0.886
			200 05 18.7	△ 26	1,140.05	3.0569258	0.708
△ 35	46 31 07.13	84 13 57.81	43 33 59.4	△ 33	751.30	2.8758107	0.467
			139 56 34.0	△ 24	574.58	2.7593524	0.357
			215 32 35.6	△ 37	1,454.91	3.1628364	0.904
△ 37	46 31 45.47	84 13 18.12	225 23 50.8	△ 39	661.01	2.8202106	0.411
			35 33 04.4	△ 35	1,454.91	3.1628364	0.904
			58 32 12.9	△ 24	1,425.18	3.1538688	0.886
			111 38 02.3	△ 26	886.28	2.9475724	0.551
			183 38 14.4	△ 28	1,279.38	3.1070010	0.795
△ 26	46 31 56.05	84 13 56.78	20 05 32.0	△ 24	1,140.05	3.0569258	0.708
			291 37 34.2	△ 37	886.28	2.9475724	0.551
			223 36 05.0	△ 28	1,312.12	3.1179735	0.815
△ 28	46 32 26.82	84 13 14.32	289 47 10.1	△ 41	1,495.29	3.1747241	0.929
			3 38 17.2	△ 37	1,279 38	3.1070010	0.795
			43 36 35.8	△ 26	1,312.12	3.1179735	0.815
			334 23 39.4	△ 39	901.16	2.9548028	0.560
			243 42 13.9	△ 30	1,576.33	3.1976474	0.979
△ 39	46 32 00.50	84 12 56.04	45 24 06.8	△ 37	661.01	2.8202106	0.411
			154 23 52.6	△ 28	901.16	2.9548028	0.560
			214 07 21.4	△ 30	1,825.14	3.2612971	1.134
△ 30	46 32 49.43	84 12 07.99	34 07 56.3	△ 39	1,825.14	3.2612971	1.134
			63 43 02.1	△ 28	1,576.33	3.1976474	0.979
			00 18 29.9	△ 41	1,204.52	3.0808124	0.748
			255 00 56.5	△ 32	1,234.32	3.0914275	0.767
△ 41	46 32 10.42	84 12 08.29	109 47 58.0	△ 28	1,495.29	3.1747241	0.929
			180 18 29.7	△ 30	1,204.52	3.0808124	0.748
			218 11 47.3	△ 32	1,938.73	3.2875167	1.205
			280 09 47.1	△ 34	2,158.23	3.3340718	1.341
			323 18 32.8	△ 43	2,258.48	3.3538172	1.403
			320 39 20.8	□ 19	1,431.06	3.1556586	0.889
			277 31 46.5	△ 34R	2,148.22	3.3320797	1.335
△ 32	46 32 59.77	84 11 12.02	75 01 37.1	△ 30	1,234.32	3.0914275	0.767
			38 12 28.1	△ 41	1,938.73	3.2875167	1.205
			334 05 32.3	△ 34	2,117.44	3.3258122	1.316
			56 11 58.3	□ 6	2,341.59	3.3695116	1.458
△ 34	46 31 58.08	84 10 28.60	247 25 42.3	△ 40	4,136.83	3.6166680	2.571
			100 10 59.5	△ 41	2,158.23	3.3340718	1.341
			154 05 03.8	△ 32	2,117.44	3.3257854	1.316
			28 27 58.3	△ 43	1,626.60	3.2112804	1.011
			296 15 51.1	△ 45	2,146.07	3.3316445	1.334
			59 12 28.8	□ 19	1,417.14	3.1514116	0.881
			6 59 05.8	□ 21	1,064.75	3.0272492	0.662
			315 49 00.8	□ 23	1,482.00	3.1708488	0.921
			101 50 04.8	□ 6	2,933.23	3.4673466	1.823
△ 43	46 31 11.77	84 11 04.98	143 19 18.7	△ 41	2,258.48	3.3538172	1.403
			208 27 32.0	△ 34	1,626.60	3.2112804	1.011
			259 54 20.3	△ 45	2,742.21	3.4381008	1.704
			241 51 10.6	□ 8	2,458.88	3.3907379	1.528
			207 02 26.1	△ 34R	1,717.04	3.2347798	1.067
△ 45	46 31 27.32	84 08 58.31	178 32 01.7	△ 36	1,548.51	3.1899146	0.962
			79 55 52.2	△ 43	2,742.21	3.4381008	1.704
			116 16 56.6	△ 34	2,146.07	3.3316445	1.334
			216 46 35.4	△ 40	3,167.29	3.5006884	1.968
			255 59 16.1	△ 38	2,668.03	3.4261909	1.658
			262 15 06.9	△ 42	4,347.09	3.6381990	2.701
			196 05 35.9	□ 25	585.97	2.7678726	0.364

TABLE NO. 4.—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, etc.*—Continued.

Station.	Latitude.	Longitude.	Azimuth.	To stations—	Distance.	Logarithms of distances.	Distance.
Lake George—Continued.	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
△ 45	46 31 27.32	84 08 58.31	197 27 46.5	□ 10	891.75	2.9502455	0.554
			221 49 41.1	□ 12	1,426.91	3.1543952	0.887
			198 49 23.4	□ 10R	928.02	2.9675594	0.577
			225 06 01.2	□ 12R	1,544.38	3.1887554	0.960
			141 58 35.9	□ 8	862.64	2.9358286	0.536
△ 40	46 32 49.47	84 07 29.31	67 27 52.4	△ 34	4,136.83	3.6166680	2.571
			36 47 40.0	△ 45	3,167.29	3.5006884	1.968
			339 54 24.4	△ 38	2,013.70	3.3039959	1.251
			308 59 39.0	△ 42	3,101.54	3.4915775	1.927
			19 01 21.4	△ 47	4,212.91	3.6245817	2.618
			10 22 26.0	□ 14	1,625.84	3.2110765	1.010
			3 10 07.8	□ 27	2,346.04	3.3703359	1.458
			351 02 43.6	□ 16	2,384.15	3.3773345	1.481
			352 28 41.7	□ 18	2,849.72	3.4548020	1.771
			346 22 37.8	□ 20	3,163.84	3.5002141	1.966
			349 40 38.2	□ 29	3,412.54	3.5330775	2.120
			342 55 39.2	□ 22	3,797.56	3.5795042	2.360
△ 38	46 31 48.22	84 06 56.85	76 00 44.2	△ 45	2,668.03	3.4261909	1.658
			159 54 48.0	△ 40	2,013.70	3.3039959	1.251
			108 57 58.6	△ 36	2,778.74	3.4438472	1.727
△ 36	46 32 17.45	84 09 00.17	358 32 00.3	△ 45	1,548.51	3.1899146	0.962
			288 56 29.1	△ 38	2,778.74	3.4438472	1.727
△ 42	46 31 46.27	84 05 36.21	82 17 33.6	△ 45	4,347.09	3.6381990	2.701
			129 01 01.0	△ 40	3,101.54	3.4915775	1.927
			61 47 40.1	△ 47	4,294.45	3.6329075	2.668
			340 18 34.0	△ 44	3,856.77	3.5862232	2.396
			93 47 16.9	□ 10	4,048.46	3.6072894	2.516
			98 08 02.0	□ 12	3,389.57	3.5301439	2.106
			97 26 56.6	□ 14	2,726.18	3.4355547	1.694
			81 16 33.2	□ 27	2,570.13	3.4099543	1.597
			78 49 55.4	□ 16	2,078.98	3.3178502	1.292
			66 48 56.4	□ 18	2,216.89	3.3457442	1.378
			56 01 30.2	□ 20	2,008.75	3.3029258	1.248
			52 01 13.8	□ 29	2,283.09	3.3585240	1.419
			37 41 10.8	□ 22	2,120.48	3.3264337	1.318
			94 12 44.3	□ 10R	4,018.63	3.6040776	2.497
			98 57 20.1	□ 12R	3,252.74	3.5122499	2.021
			308 38 25.1	△ 42½	4,688.44	3.6170286	2.913
			25 28 36.5	Churchs Point Crib.	3,085.02	3.4893576	1.917
			87 38 19.1	Manchester Shoals Crib.	2,473.86	3.3932568	1.537
△ 47	46 30 40.47	84 08 33.72	199 00 34.7	△ 40	4,212.91	3.6245817	2.618
			241 44 31.3	△ 42	4,294.45	3.6329075	2.668
			287 26 58.0	△ 44	5,330.30	3.7267521	3.312
			326 17 22.1	△ 46	6,682.68	3.8249507	4.152
			326 11 04.2	△ 46 R	6,687.40	3.8252576	4.155
△ 44	46 29 48.64	84 04 35.26	160 19 18.2	△ 42	3,856.77	3.5862232	2.396
			107 29 51.0	△ 47	5,330.30	3.7267521	3.312
			19 12 29.4	△ 46	4,192.90	3.6225139	2.605
			60 51 20.3	△ 49	6,526.48	3.8146787	4.055
			253 25 37.5	△ 42½	2,465.11	3.3918370	1.532
			19 03 19.6	△ 46R	4,185.99	3.6217983	2.601
			60 54 05.9	△ 49R	6,529.55	3.8148835	4.057
			107 51 20.7	Churchs Point Crib.	2,759.55	3.4408387	1.715
△ 46	46 27 40.40	84 05 39.90	199 11 42.6	△ 44	4,192.90	3.6225139	2.605
			1?6 19 28.1	△ 47	6,682.68	3.8249507	4.152
			100 13 58.9	△ 49	4,390.74	3.6425377	2.728
			20 23 17.5	△ 48	7,544.50	3.8776306	4.688
			146 34 00.1	□ 31	6,059.15	3.7824115	3.765
△ 49	46 28 05.60	84 09 02.41	240 48 06.6	△ 44	6,526.48	3.8146787	4.055
			280 11 32.1	△ 46	4,390.74	3.6425377	2.728
			347 47 41.1	△ 48	8,032.25	3.9048371	4.991
			28 22 55.3	△ 51	5,882.64	3.7695723	3.655
			192 53 53.6	□ 31	4,387.92	3.6422584	2.727
△ 48	46 23 51.33	84.07 42.91	200 21 48.4	△ 46	7,544.50	3.8776306	4.688
			167 48 38.7	△ 49	8,032.25	3.9048371	4.991
			120 46 40.2	△ 51	5,230.33	3.7185294	3.250
			36 43 23.3	△ 53	2,682.65	3.4285635	1.667
			340 13 47.3	△ 50	2,576.21	3.4109819	1.601

TABLE No. 4—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, etc.*—Continued.

Station.	Latitude.	Longitude.	Azimuth.	To stations—	Distance.	Logarithms of distances.	Distance.
Lake George—Continued.	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
△48	46 23 51.33	84.07 42.91	138 07 42.6	□33	5,261.53	3.7211119	3.269
			166 18 49.8	Crib E (1879)	1,942.35	3.2883276	1.207
			166 15 54.6	Crib E (1881)	1,940.53	3.2879204	1.206
			127 59 15.7	Crib W (1879)	2,807.70	3.4483514	1.745
			127 58 36.5	Crib W (1881)	2,809.39	3.4486120	1.746
			127 54 26.0	Crib W (1882)	2,807.95	3.4483887	1.745
			101 35 13.6	□35	4,147.36	3.6177717	2.577
			43 11 04.3	□37	1,655.36	3.2188935	1.029
			349 03 49.8	□24	765.68	2.8840482	0.476
			3 23 55.3	□26	3,181.14	3.5025828	1.977
			25 25 38.9	□39	2,354.21	3.3718448	1.463
△51	46 25 17.95	84 11 13.35	300 44 07.8	△48	5,230.33	3.7185294	3.250
			208 21 20.4	△49	5,882.64	3.7695723	3.655
			329 02 59.2	△53	5,625.51	3.7501619	3.496
			218 17 40.4	□33	1,582.84	3.1994379	0.984
			290 39 53.8	Light-house. Lake George.	3,336.83	3.5233336	2.073
			343 33 58.0	□35	1,700.99	3.2307028	1.057
			303 50 48.8	Crib foot of flats, Lake George.	4,273.01	3.6307340	2.655
			188 53 16.5	△31½	2,026.02	3.3066438	1.259
△53	46 22 41.68	84 08 57.96	149 04 37.2	△51	5,625.51	3.7501619	3.496
			216 42 29.0	△48	2,682.65	3.4285635	1.667
			276 18 14.6	△50	2,490.62	3.3963075	1.548
			323 30 08.2	△54	4,007.84	3.6029100	2.490
			305 54 09.0	□26	1,747.82	3.2424978	1.086
			171 03 50.3	Crib W (1879)	3,925.84	3.5939331	2.439
			171 02 29.6	Crib W (1881)	3,926.70	3.5940283	2.440
			171 01 10.3	Crib W (1882)	3,923.32	3.5936543	2.438
△50	46 22 32.81	84 07 02.13	160 14 16.8	△48	2,576.21	3.4109819	1.601
			96 19 38.5	△53	2,490.62	3.3963075	1.548
			1 48 19.8	△54	2,949.77	3.4697875	1.833
			121 16 55.3	□37	2,344.98	3.3701400	1.457
			99 00 33.9	□39	1,905.72	3.2800582	1.184
			323 32 46.8	△52	2,010.46	3.3032952	1.249
△54	46 20 57.32	84 07 06.47	181 48 16.8	△50	2,949.77	3.4697875	1.833
			143 31 28.9	△53	4,007.84	3.6029100	2.490
			224 02 34.3	△52	1,851.97	3.2676334	1.151
			309 21 58.1	△56	2,851.46	3.4550670	1.772
			351 41 08.3	△55	3,003.12	3.4775734	1.866
			111 31 20.6	△43	769.80	2.8863765	0.478
			163 39 16.9	□28	929.16	2.9680890	0.577
			48 54 34.6	□45	743.26	2.8711430	0 462
			2 05 40.9	□47	1,294.74	3.1121827	0.805
△52	46 21 40.43	84 06 06.25	143 33 27.2	△50	2,010.46	3.3032952	1.249
			44 03 17.9	△54	1,851.97	3.2676334	1.151
			343 43 52.9	△56	3,271.00	3.5146807	2.033
			62 22 53.6	□43	2,261.52	3.3543995	1.405
△56	46 19 58.73	84 05 23.40	163 44 23.9	△52	3,271.00	3.5146807	2.033
			129 23 12.7	△54	2,851.46	3.4550670	1.772
			56 43 03.5	△55	2,118.05	3.3259367	1.316
			20 47 55.1	△58	2,865.24	3.4571607	1.780
			27 00 57.9	□34	1,953.48	3.2908089	1.214
△55	46 19 21.07	84 06 46.16	171 41 23.0	△54	3,003.12	3.4775734	1.866
			236 42 03.6	△56	2,118.05	3.3259367	1.316
			333 33 56.2	△58	1,693.00	3.2286577	1.052
			38 39 31.4	□59	1,589.62	3.2012937	0.988
			352 28 16.8	□36	1,071.58	3.0300252	0.666
			76 13 44.0	□51	927.82	2.9674657	0.577
			303 10 58.4	□34	1,035.60	3.0234989	0.656
			183 52 01.0	□32	1,197.18	3.0781620	0.744
			288 01 05.5	Shoal Island Light.	3,178.64	3.5022417	1.975
Little Mud Lake:							
△58	46 18 31.97	84 06 10.94	153 34 21.7	△55	1,693.00	3.2286577	1.052
			200 47 20.7	△56	2,865.24	3.4571607	1.780
			98 56 39.7	□59	1,768.15	3.2475193	1.099
			41 18 05.7	△59	2,466.36	3.3920562	1.533

TABLE No. 4.—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, etc.*—Continued.

Stations.	Latitude.	Longitude.	Azimuth.	To stations—	Distance.	Logarithms of distances.	Distance.
Little Mud Lake —Continued.	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
□ 59 Neebish.	46 18 40.86	84 07 32.56	126 09 14.9	△ 57	1,758.15	3.2450559	1.092
			261 00 27.8	□ 36	1,147.45	3.0597345	0.713
			218 38 57.8	△ 55	1,589.62	3.2012937	0.988
			278 55 40.7	△ 58	1,768.15	3.2475193	1.099
			356 47 16.0	△ 59	2,131.06	3.3285951	1.324
			327 53 31.7	△ 60	2,497.30	3.3974700	1.552
			185 08 28.7	□ 51	1,024.61	3.0105584	0.637
			163 25 10.4	□ 53	1,449.31	3.1611608	0.901
□ 36	46 18 46.67	84 06 39.60	81 01 06.1	□ 59	1,147.45	3.0597345	0.713
			172 28 21.5	△ 55	1,071.58	3.0300252	0.666
			128 56 09.8	□ 51	1,338.75	3.1267001	0.832
△ 59	46 17 31.94	84 07 26.98	221 17 10.7	△ 58	2,466.36	3.3920562	1.533
			176 47 20.0	□ 59	2,131.06	3.3285951	1.324
			269 24 51.3	△ 60	1,208.00	3.0820669	0.751
			349 29 28.2	△ 61	2,288.21	3.3594956	1.422
			329 11 57.2	△ 62	2,406.90	3.3814573	1.496
△ 60	46 17 32.34	84 06 30.55	89 25 32.1	△ 59	1,208.00	3.0820669	0.751
			147 54 16.5	□ 59	2,497.30	3.3974700	1.552
			19 16 30.5	△ 61	2,396.35	3.3795508	1.489
△ 61	46 16 19.06	84 07 07.48	199 16 03.8	△ 60	2,396.35	3.3795508	1.489
			169 29 42.2	△ 59	2,288.21	3.3594956	1.422
			257 23 27.0	△ 62	835.30	2.9218409	0.519
			322 48 59.4	△ 63	1,236.79	3.0922963	0.769
			282 54 44.6	△ 64	1,093.82	3.0389447	0.680
△ 62	46 16 24.96	84 06 29.42	77 23 54.5	△ 61	835.30	2.9218409	0.519
			149 12 38.8	△ 59	2,406.90	3.3814573	1.496
			3 19 27.9	△ 63	1,169.67	3.0680618	0.727
△ 63	46 15 47.14	84 06 32.58	183 19 25.6	△ 62	1,169.67	3.0680618	0.727
			142 49 24.6	△ 61	1,236.79	3.0922963	0.769
			203 16 46.6	△ 64	806.55	2.9066338	0.501
			265 15 57.9	△ 66	926.28	2.9667418	0.576
			320 44 23.0	△ 63½	598.92	2.7773715	0.372
△ 64	46 16 11.14	84 06 17.70	23 16 57.4	△ 63	806.55	2.9066338	0.501
			102 55 20.6	△ 61	1,093.82	3.0389447	0.680
			317 42 52.9	△ 66	898.19	2.9533662	0.558
△ 66	46 15 49.62	84 05 49.48	315 25 24.4	△ 70	1,460.88	3.1646142	0.908
			137 43 13.3	△ 64	898.19	2.9533662	0.558
			85 16 29.6	△ 63	926.28	2.9667418	0.576
			45 12 54.7	△ 63½	766.70	2.8846268	0.476
			13 01 52.2	△ 65	974.34	2.9887116	0.605
			354 52 14.4	△ 68	1,349.65	3.1302216	0.839
			3 54 52.9	△ 72	2,414.35	3.3828011	1.500
			53 39 24.5	△ 95	1,625.35	3.2109479	1.010
△ 63½	46 15 32.12	84 06 14.88	225 12 36.3	△ 66	766.70	2.8846268	0.476
			321 34 43.3	△ 65	522.19	2.7178318	0.324
			140 44 35.8	△ 63	598.92	2.7773715	0.372
△ 65	46 15 18.87	84 05 59.73	357 50 33.4	△ 72	1,460.38	3.1644656	0.907
			141 34 54.3	△ 63½	522.19	2.7178318	0.324
			193 01 44.8	△ 66	974.34	2.9887116	0.605
			319 14 49.6	△ 68	521.41	2.7171774	0.324
			274 11 41.4	△ 70	1,248.38	3.0963478	0.776
△ 68	46 15 06.07	84 05 43.84	174 52 18.4	△ 66	1,349.65	3.1302216	0.839
			139 15 01.0	△ 65	521.41	2.7171774	0.324
△ 70	46 15 15.91	84 05 01.62	94 12 23.4	△ 65	1,248.38	3.0963478	0.776
			135 25 59.0	△ 66	1,460.88	3.1646142	0.908
			41 01 50.5	△ 72	1,813.22	3.2584498	1.127
			74 36 06.9	△ 91	1,717.69	3.2349443	1.067
△ 72	46 14 31.59	84 05 57.16	221 01 10.4	△ 70	1,813.22	3.2584498	1.127
			183 54 47.4	△ 66	2,414.35	3.3828011	1.500
			177 50 35.3	△ 65	1,460.38	3.1644656	0.907
			152 55 53.1	△ 91	1,023.75	3.0101921	0.636
			79 08 24.8	△ 93	1,292.69	3.1114952	0.803
			141 37 50.3	△ 95	1,843.65	3.2656792	1.146
			76 57 00.1	△ 97	2,359.72	3.3728597	1.466

TABLE NO. 4.—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, etc.*—Continued.

Station.	Latitude.	Longitude.	Azimuth.	To stations—	Distance.	Logarithms of distances.	Distance.
Little Mud Lake —Continued.	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
△ 91	46 15 01.12	84 06 18.91	332 55 37.4	△ 72	1,023.75	3.0101921	0.636
			254 35 11.1	△ 70	1,717.69	3.2349443	1.067
			34 49 23.2	△ 93	1,407.23	3.1483648	0.874
			347 31 54.0	△ 74	1,356.04	3.1322740	0.843
△ 93	46 14 23.70	84 06 56.42	214 48 56.1	△ 91	1,407.23	3.1483648	0.874
			259 07 42.0	△ 72	1,292.69	3.1114952	0.803
			278 44 50.5	△ 74	1,109.29	3.0450434	0.689
△ 74	46 14 17.23	84 06 05.25	98 45 27.5	△ 93	1,109.29	3.0450434	0.689
			167 32 03.9	△ 91	1,356.04	3.1322740	0.843
△ 95	46 15 18.41	84 06 50.60	223 38 40.3	△ 66	1,625.35	3.2109479	1.010
			321 37 11.7	△ 72	1,843.65	3.2656792	1.146
			30 15 12.0	△ 97	2,290.46	3.3599224	1.423
			327 45 56.3	△ 98	3,393.46	3.5306426	2.109
△ 97	46 14 14.31	84 07 44.45	210 14 33.1	△ 95	2,290.46	3.3599224	1.423
			256 55 42.6	△ 72	2,359.72	3.3728597	1.466
			286 44 11.8	△ 98	3,095.29	3.4907014	1.923
			34 01 45.6	◬ Winter Pt.	2,833.72	3.4523575	1.761
△ 98	46 13 45.42	84 05 26.12	106 45 51.6	△ 97	3,095.29	3.4907014	1.923
			147 46 57.3	△ 95	3,393.46	3.5306426	2.109
			72 16 13.1	◬ Winter Pt.	4,777.59	3.6792093	2.969
Middle Neebish:			22 01 03.0	◬ Rocky Pt.	5,992.79	3.7776289	3.724
□ 51	46 19 13.92	84 07 28.28	256 13 13.5	△ 55	927.82	2.9674657	0.577
			5 08 31.8	□ 59	1,024.61	3.0105584	0.637
			308 55 34.6	□ 36	1,338.75	3.1267001	0.832
			90 37 45.7	△ 57	1,511.51	3.1794105	0.939
□ 53	46 19 25.86	84 07 51.90	70 43 15.7	△ 57	1,065.76	3.0276585	0.662
			343 24 56.4	□ 59	1,449.31	3.1611608	0.901
			104 05 25.6	□ 55	1,944.14	3.2887277	1.208
△ 57	46 19 14.45	84 08 38.92	270 36 54.6	□ 51	1,511.51	3.1794105	0.939
			306 08 26.9	□ 59	1,758.15	3.2450559	1.092
			250 42 41.7	□ 53	1,065.76	3.0276585	0.662
			133 09 37.9	□ 55	1,206.12	3.0813914	0.749
			100 36 22.0	△ 67	1,522.50	3.1825588	0.946
			183 47 17.4	□ C (1883)	932.52	2.9696609	0.579
□ 55	46 19 41.18	84 09 20.05	313 09 08.2	△ 57	1,206.12	3.0813914	0.749
			284 04 21.8	□ 53	1,944.14	3.2887277	1.208
			122 28 25.9	△ 71	856.02	2.9324840	0.532
			272 39 34.0	□ C (1883)	783.39	2.8939773	0.487
			48 31 59.3	△ 67	822.86	2.9153266	0.511
△ 67	46 19 23.52	84 09 48.87	158 14 26.5	△ 73	2,126.41	3.3276481	1.321
			228 31 38.5	□ 55	822.86	2.9153266	0.511
			280 35 31.4	△ 57	1,522.50	3.1825588	0.946
			173 59 43.7	△ 71	1,010.04	3.0043400	0.628
			100 03 19.4	△ 69	1,424.32	3.1536088	0.885
△ 71	46 19 56.06	84 09 53.81	353 59 40.1	△ 67	1,010.04	3.0043400	0.628
			302 28 01.5	□ 55	856.02	2.9324840	0.532
			59 45 50.0	△ 69	1,500.97	3.1763714	0.933
△ 69	46 19 31.57	84 10 54.43	239 45 06.2	△ 71	1,500.97	3.1763714	0.933
			280 02 32.0	△ 67	1,424.32	3.1536088	0.885
			199 34 17.9	△ 73	1,832.22	3.2629788	1.139
			117 21 24.4	△ 76	3,586.98	3.5547286	2.229
Miscellaneous locations:							
△ 8*	46 30 22.63	84 19 36.12	339 21 55.9	□ 13	1,435.48	3.1569969	0.892
			80 16 14.3	□ 9	1,300.55	3.1141262	0.808
□ 13	46 29 39.12	84 19 12.41	159 22 13.1	△ 8*	1,435.48	3.1569969	0.892
			264 58 51.7	△ 14	1,909.91	3.2810128	1.187
□ 9	46 30 15.51	84 20 36.24	120 56 00.8	△ 6*	1,290.26	3.1106786	0.802
			260 15 30.7	△ 8*	1,300.55	3.1141262	0.808
△ 9*	46 29 41.60	84 21 12.61	238 40 00.6	□ 11	1,291.38	3.1110547	0.802
△ 6*	46 30 36.98	84 21 28.15	300 55 23.1	□ 9	1,290.26	3.1106786	0.802
			305 54 06.3	□ 11	1,770.76	3.2481591	1.100

*These stations, △ 6, △ 8, △9, are not those in Hay Lake, but on river near Sault Ste. Marie.

TABLE No. 4.—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, etc.*—Continued.

Station.	Latitude.	Longitude.	Azimuth	To stations—	Distance.	Logarithms of distances.	Distance.
Miscellaneous location—Cont'd.	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
□ 11	46 30 03.35	84 20 20.88	125 54 55.1	△ 6*	1,770.76	3.2481591	1.100
			58 40 38.1	△ 9*	1,291.38	3.1110547	0.802
□ 4	46 30 14.35	84 18 31.22	311 57 40.5	△ 14	1,377.27	3.1390196	0.856
			363 24 18.4	△ 21	1,638.25	3.2143792	1.018
□ 17	46 29 42.60	84 15 49.72	96 49 59.3	△ 16	910.52	2.9592880	0.566
			144 13 06.8	△ 18	322.13	2.5080354	0.200
□ 19	46 31 34.58	84 11 25.72	140 39 51.7	△ 41	1,431.06	3.1556586	0.889
			239 11 47.4	△ 34	1,417.14	3.1514116	0.881
			286 55 48.4	□ 21	1,137.23	3.0558502	0.707
□ 21	46 31 23.85	84 10 34.68	106 56 25.4	□ 19	1,137.23	3.0558502	0.707
			186 29 01.3	△ 34	1,064.75	3.0272492	0.662
			270 17 25.4	□ 23	1,162.38	3.0653500	0.722
□ 23	46 31 23.66	84 09 40.14	90 18 04.9	□ 21	1,162.38	3.0653500	0.722
			135 49 35.9	△ 34	1,482.00	3.1708488	0.921
□ 8	46 31 49.32	84 09 23.25	61 52 24.4	△ 43	2,458.88	3.3907379	1.528
			321 58 17.8	△ 45	862.64	2.9358286	0.536
			279 31 50.8	□ 25	703.52	2.8472780	0.437
□ 25	46 31 45.55	84 08 50.69	99 32 14.5	□ 8	703.52	2.8472780	0.437
			16 05 41.5	△ 45	585.97	2.7678726	0.364
□ 10	46 31 54.87	84 08 45.76	17 27 55.6	△ 45	891.75	2.9502455	0.554
			273 44 59.3	△ 42	4,048.46	3.6072894	2.516
□ 12	46 32 01.75	84 08 13.66	41 50 13.5	△ 45	1,426.91	3.1543952	0.887
			278 06 07.7	△ 42	3,389.57	3.5301439	2.106
□ 6	46 32 17.57	84 12 43.33	236 10 52.0	△ 32	2,341.59	3.3695116	1.458
			281 49 27.0	△ 34	2,933.23	3.4673466	1.823
□ 14	46 31 57.68	84 07 43.05	190 22 16.0	△ 40	1,625.84	3.2110765	1.010
			277 25 24.4	△ 42	2,726.18	3.4355547	1.694
□ 27	46 31 33.61	84 07 35.39	183 10 03.4	△ 40	2,346.04	3.3703359	1.458
			261 15 06.8	△ 42	2,570.13	3.4099543	1.597
□ 16	46 31 33.20	84 07 11.90	171 02 56.2	△ 40	2,384.15	3.3773345	1.481
			258 48 45.8	△ 42	2,078.98	3.3178502	1.292
□ 18	46 31 17.97	84 07 11.81	172 28 54.4	△ 40	2,849.72	3.4548020	1.771
			246 47 47.0	△ 42	2,216.89	3.3457442	1.378
□ 20	46 31 09.89	84 06 54.35	166 23 03.2	△ 40	3,163.84	3.5002141	1.966
			236 00 33.6	△ 42	2,008.75	3.3029258	1.248
□ 29	46 31 00.74	84 07 00.62	169 40 59.0	△ 40	3,412.54	3.5330775	2.120
			232 00 12.6	△ 42	2,283.09	3.3585240	1.419
□ 22	46 30 51.90	84 06 37.01	162 56 17.2	△ 40	3,797.56	3.5795042	2.360
			217 40 26.6	△ 42	2,120.48	3.3264337	1.318
□ 31	46 30 24.13	84 08 16.48	326 32 06.6	△ 46	6,059.15	3.7824115	3.765
			12 54 26.9	△ 49	4,387.92	3.6422584	2.727
□ 31½	46 26 22.79	84 10 58.69	318 40 22.9	□ 33	1,011.32	3.0048894	0.628
			8 53 27.1	△ 51	2,026.02	3.3066438	1.259
□ 33	46 25 58.19	84 10 27.41	138 40 45.6	□ 31½	1,011.32	3.0048894	0.628
			318 05 43.4	△ 48	5,261.53	3.7211119	3.269
			38 18 13.7	△51	1,582.84	3.1994379	0.984
			9 52 21.9	□ 35	2,916.89	3.4649201	1.812
Crib E (1881)	46 24 52.38	84 08 04.48	346 15 39.0	△ 48	1,940.53	3.2879204	1.206
			84 54 18.1	Crib W (1881)	1,760.82	3.2457141	1.094
Crib W (1881)	46 24 47.30	84 09 26.60	264 53 18.6	Crib E (1881)	1,760.82	3.2457141	1.094
			307 57 21.4	△ 48	2,809.39	3.4486120	1.746
			351 02 08.8	△ 53	3,926.70	3.5940283	2.440
Crib E (1879)	46 24 52.45	84 08 04.43	346 18 34.2	△ 48	1,942.35	3.2883276	1.207
			84 48 40.8	Crib W (1879)	1,760.51	3.2456378	1.094

* These stations, △ 6, △ 8, △ 9, are not those in Hay Lake, but on river near Sault Ste. Marie.

TABLE NO. 4.—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, etc.*—Continued.

Station.	Latitude.	Longitude.	Azimuth.	To stations—	Distance.	Logarithms of distances.	Distance.
Miscellaneous locations—Cont'd.	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
Crib W (1879)	46 24 47.28	84 09 26.52	264 47 41.4	Crib E (1879)	1,760.51	3.2456378	1.094
			307 58 00.7	△ 48	2,807.70	3.4483514	1.745
			351 03 29 6	△ 53	3,925.84	3.5939331	2.439
Crib W (1882)	46 24 47.19	84 09 26.64	307 53 10.9	△ 48	2,807.95	3.4483887	1.745
			351 00 49.5	△ 53	3,923.32	3.5936543	2.438
□ 35	46 24 25.11	84 10 50.81	163 34 14.3	△ 51	1,700.99	3.2307028	1.057
			283 42 57.6	Crib foot of flats.	3,157.63	3.4993612	1.962
			189 52 04.9	□ 33	2,916.89	3.4649201	1.812
			284 32 59.5	□ 48	4,147.36	3.6177717	2.577
			260 15 05.8	Light-house, Lake George.	2,679.64	3.4280760	1.665
□ 37	46 23 12.23	84 08 35.92	223 10 25.9	△ 48	1,655.36	3.2188935	1.029
			301 15 47.4	△ 50	2,344.98	3.3701400	1.457
			250 23 03.9	□ 24	1,356.76	3.1325041	0.843
			352 25 43.7	△ 39	927.25	2.9671970	0.576
□ 24	46 23 26.98	84 07 36.11	169 03 54.7	△ 48	765.68	2.8840482	0.476
			70 23 47.2	□ 37	1,356.76	3.1325041	0.843
□ 39	46 22 42.46	84 08 30.20	278 59 30.2	△ 50	1,905.72	3.2800582	1.184
			172 25 47.8	□ 37	927.25	2.9671970	0.576
			205 25 04.6	△ 48	2,354.21	3.3718448	1.463
□ 26	46 22 08.48	84 07 51.72	183 23 48.9	△ 48	3,181.14	3.5025826	1.977
			125 54 56.9	△ 53	1,747.82	3.2424978	1.086
□ 43	46 21 06.46	84 07 39.96	312 58 43.6	□ B (1881)	834.30	2.9213213	0.518
			289 08 35.0	□ A (1881)	555.43	2.7446278	0.345
			291 30 56.4	△ 54	769.80	2.8863765	0.478
			242 21 45.8	△ 52	2,261.52	3.3543995	1.405
			216 43 37.0	△ 28	760.14	2.8808913	0.472
			149 53 24.4	□ 41	901.73	2.9550784	0.560
			348 33 27.4	□ 45	786.54	2.8957181	0.489
□ 28	46 21 26.19	84 07 18.70	343 39 08.1	△ 54	929.16	2.9680890	0.577
			36 43 52.4	□ 43	760.14	2.8808913	0.472
			100 40 14.1	□ 41	922.87	2.9651416	0.573
□ 41	46 21 31.72	84 08 01.12	329 53 09.1	□ 43	901.73	2.9550784	0.560
			280 39 43.4	□ 28	922.87	2.9651416	0.573
□ A (1881)	46 21 00.56	84 07 15.42	109 08 52.7	□ 43	555.43	2.7446278	0.345
			32 03 35.0	□ 45	694.67	2.8417786	0.432
□ B (1881)	46 20 48.04	84 07 11.42	66 01 16.7	□ 45	497.28	2.6966011	0.309
			132 59 04.2	□ 43	834.30	2.9213213	0.518
□ C (1883)	46 19 39.76	84 08 36.51	3 47 19.1	△ 57	932.52	2.9696609	0.579
			92 40 05.5	□ 55	783.39	2.8939773	0.487
□ 45	46 20 41.49	84 07 32.66	212 03 22.6	□ A (1881)	694.67	2.8417786	0.432
			228 54 15.7	△ 54	743.26	2.8711430	0.462
			168 33 32.7	□ 43	786.54	2.8957181	0.489
			327 30 21.3	□ 47	954.80	2.9799102	0.593
			246 01 01.4	□ B (1881)	497.28	2.6966011	0.309
□ 47	46 20 15.41	84 07 08.68	182 05 39.3	△ 54	1,294.74	3.1121827	0.805
			147 30 38.6	□ 45	954.80	2.9799102	0.593
Light-house, Lake George.	46 24 39.79	84 08 47.14	110 41 39.6	△ 51	3,336.83	3.5233336	2.073
			80 16 35.4	□ 35	2,679.64	3.4280760	1.665
			273 41 01.4	◬ Laird	8,517.11	3.9302922	5.292
			160 23 38.9	◬ Rankin Mt.	19,084.19	4.2806737	11.858
Crib foot of flats, Lake George.	46 24 00.84	84 08 27.21	123 52 49.1	△ 51	4,273.01	3.6307340	2.655
			103 44 41.6	□ 35	3,157.63	3.4993612	1.962
□ 34	46 19 02.36	84 06 04.87	123 11 28.2	△ 55	1,035.60	3.0234989	0.656
			207 00 27.9	△ 56	1,953.48	3.2908089	1.214
			155 38 24.3	□ 32	1,945.53	3.2890370	1.209
□ 32	46 19 59.76	84 06 42.39	335 37 57.2	□ 34	1,945.53	3.2890370	1.209
			3 52 03.7	△ 55	1,197.18	3.0781620	0.744
			306 30 34.2	Shoal Island Light.	3,660.29	3.5635159	2.274

TABLE No. 4—*Geographical positions of the stations of the tertiary triangulation of the river, by all channels, etc.*—Continued.

Station.	Latitude.	Longitude.	Azimuth.	To stations—	Distance.	Logarithms of distances.	Distance.
Miscellaneous locations—Cont'd.	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*	*Miles.*
Shoal Island Light.	46 18 49.21	84 04 24.88	108 02 47.6	△ 55	3,178.64	3.5022417	1.975
			126 32 13.6	□ 32	3,660.29	3.5635159	2.274
△ 34 R	46 32 01.30	84 10 28.35	27 02 52.7	△ 43	1,717.04	3.2347798	1.067
			97 32 59.1	△ 41	2,148.22	3.3320797	1.335
□ 10 R	46 31 55.76	84 08 44.26	274 10 27.8	△ 42	4,018.63	3.6040776	2.497
			18 49 33.6	△ 45	928.02	2.9675594	0.577
□ 12 R	46 32 02.62	84 08 06.98	278 55 30.6	△ 42	3,252.74	3.5122499	2.021
			45 06 38.4	△ 45	1,544.38	3.1887554	0.960
			309 18.44.6	Manchester Shoals Crib.	959.45	2.9820214	0.596
Manchester Shoals Crib.	46 31 42.93	84 07 32.13	129 19 09.9	□ 12 R	959.45	2.9820214	0.596
			267 36 54.9	△ 42	2,473.86	3.3932568	1.537
△ 42½	46 30 11.40	84 02 44.46	73 26 57.9	△ 44	2,465.11	3.3918370	1.532
			128 40 29.8	△ 42	4,688.44	3.6710286	2.913
Crib, Churchs Point.	46 30 16.02	84 06 38.45	205 27 51.3	△ 42	3,085.02	3.4893576	1.917
			287 49 51.3	△ 44	2,759.55	3.4408387	1.715
△ 46 R	46 27 40.49	84 05 39.30	199 02 33.2	△ 44	4,185.99	3.6217983	2.601
			100 11 39.0	△ 49 R	4,408.55	3.6442956	2.739
			146 13 10.7	△ 47	6,687.40	3.8252576	4.155
			57 29 18.4	Crib at head of flats.	5,464.67	3.7375642	3.396
△ 49 R	46 28 05.70	84 09 02.66	240 50 52.0	△ 44	6,529.55	3.8148835	4.057
			280 09 11.5	△ 46 R	4,408.55	3.6442956	2.739
			4 06.10.0	Crib at head of flats.	3,727.08	3.5713689	2.316
Crib at head of flats.	46 26 05.32	84 09 15.14	237 26 42.0	△ 46 R	5,464.67	3.7375642	3.396
			184 06 01.0	△ 49 R	3,727.08	3.5713689	2.316
◬ Laird	46 24 21.88	84 02 09.23	93 45 49.6	Light-house, Lake George.	8,517.11	3.9302922	5.292
◬ Rankin Mt	46 34 21.90	84 13 47.85	340 20 00.8	Light-house, Lake George.	19,084.19	4.2806737	11.858
Magnetic No. 1, Soo (in old Fort Brady garden).	46 29 55.72	84 20 26.28	197 32 53	International Hotel.	.....	.....	.....
			232 41 03	Catholic Ch., Canada.	.....	.....	.....
			277 09 13	St. Marys Ch.	.....	.....	.....
			65 10 48	Fort Brady flagstaff.	.....	.....	.....
			78 26 33	Court-house flagstaff.	190.1	.....	.....
Magnetic No. 2, Soo on hill near ◬ Soo.	46 29 09.87	84 21 15.39	40 36 26	◬ Larke	.....	.....	.....
			164 07 01	Fort Brady flagstaff.	.....	.....	.....
			207 07 31	International Hotel.	.....	.....	.....
			211 59 54	Court-house	.....	.....	.....
			219 50 05	St. Marys Ch.	.....	.....	.....
			224 16 11	Catholic Ch., Canada.	.....	.....	.....
			271 21 10	◬ Soo	46.80	.....	.....

TABLE NO. 5.—*Tertiary triangulation, St. Marys River, Sailors Encampment to Detour.*

Stations.	Adjusted angles.	Sides.	Sides.
Chimney of dwelling of Winter Point Light-House	° ′ ″	*Meters.*	*Miles.*
Ross	99 54 14.20	7,744.81	4.813
Rocky Point	38 04 38.90	4,848.70	3.013
	42 01 06.90	5,262.60	3.270
Iron tower, back range, Winter Point	99 21 27.65	7,744.81	4.813
Ross	38 27 47.25	4,882.33	3.034
Rocky Point	42 10 45.10	5,270.40	3.274
Iron tower, back range, Winter Point	133 28 01.02	5,421.67	3.369
Ross	1 39 39.78	216.54	0.134
Winter Point	44 52 19.20	5,270.42	3.274
Smokestack, tallest of three, at Sailors Encampment	80 52 09.30	7,744.81	4.813
Ross	92 01 06.40	7,839.34	4.872
Rocky Point	7 06 44.30	971.23	0.603
Post of crib light at Ross's	61 43 37.50	7,744.81	4.813
Ross	114 49 45.50	7,981.03	4.960
Rocky Point	3 26 37.00	528.21	0.328
Post of crib light at Ross's	34 41 18.81	4,704.61	2.924
Rocky Point	40 12 53.28	5,337.32	3.317
Winter Point	105 05 47.91	7,981.23	4.960
Pilot Island, front range light	88 07 25.00	4,704.61	2.924
Winter Point	11 43 07.50	956.05	0.594
Rocky Point	80 09 27.50	4,637.81	2.884
Round Island Light-House	30 35 24.87	7,744.34	4.813
Pointe aux Frênes	139 27 32.06	9,891.57	6.146
Salters Hill	9 57 03.07	2,629.71	1.634
Round Island Light-House	75 12 39.09	9,607.03	5.969
Salters Hill	20 13 47.18	9,891.43	6.146
⊙ 208	84 33 33.73	3,435.80	2.136
Post of Sweets Point Light	31 51 02.68	7,324.73	4.551
Raber	112 25 28.95	12,830.67	7.974
Pointe aux Frênes	35 43 28.37	8,104.54	5.036
Post of Sweets light	53 34 52.73	14,744.29	9.163
Raber	100 09 57.41	18,035.07	11.208
Salters Hill	26 15 09.78	8,104.71	5.036
Pipe Island Light-House	86 02 58.80	3,831.76	2.381
Detour	54 24 28.70	3,123.34	1.940
Drummond	39 32 32.50	2,445.24	1.520
Pipe Island Light-House	42 58 08.00	14,744.29	9.162
Raber	104 35 56.50	20,933.43	13.008
Salters Hill	32 25 55.50	11,601.15	7.209
Pipe Island Light-House	26 36 02.00	6,559.94	4.076
Raber	25 45 31.00	6,366.74	3.955
Fort St. Joe	127 38 27.00	11,600.91	7.209
Frying Pan Light-House	72 21 45.46	23,434.45	14.563
Salters Hill	6 41 03.65	2,862.30	1.778
Drummond	100 57 10.89	24,142.41	15.002

Stations.	Adjusted angles.	Sides.	Sides.
Frying Pan Light-House	° ′ ″	*Meters.*	*Miles.*
Salters Hill	50 53 53.62	19,570.88	12.160
Bacon Island	22 18 00.41	9,569.68	5.946
	106 48 05.97	24,142.75	15.003
⊙ 200	68 28 27.37	5,421.67	3.369
Ross	60 39 37.53	5,080.59	3.157
Winter Point	50 51 55.10	4,520.70	2.809
⊙ 200	60 48 26.55	4,704.61	2.924
Rocky Point	70 31 06.25	5,080.57	3.157
Winter Point	48 40 27.20	4,047.04	2.515
⊙ 201	66 37 03.65	10,327.55	6.417
Ross	51 17 13.49	8,779.48	5.455
Salters Hill	62 05 42.86	9,943.31	6.178
⊙ 201	99 39 08.11	13,017.28	8.089
Winter Point	41 40 38.24	8,779.95	5.455
Salters Hill	38 40 13.65	8,250.54	5.126
⊙ 202	43 13 59.62	4,704.61	2.924
Rocky Point	100 08 11.00	6,761.00	4.201
Winter Point	36 37 49.38	4,098.00	2.547
⊙ 202	48 21 18.74	5,421.67	3.369
Winter Point	62 54 32.95	6,459.21	4.013
Ross	68 44 08.31	6,761.26	4.201
⊙ 202 A	28 58 04.31	4,704.61	2.924
Rocky Point	118 50 26.69	8,508.99	5.287
Winter Point	32 11 29.00	5,175.05	3.215
⊙ 203	89 08 12.17	13,017.28	8.089
Winter Point	37 20 15.64	7,896.03	4.907
Salters Hill	53 31 32.19	10,468.61	6.505
⊙ 204	82 31 27.47	8,892.73	5.526
Pointe aux Frênes	74 25 20.08	8,639.50	5.369
Rocky Point	23 03 12.45	3,512.15	2.182
⊙ 204	45 42 04.71	9,926.12	6.167
Fort St. Joe	14 40 10.20	3,512.21	2.182
Pointe aux Frênes	119 37 45.09	12,055.48	7.491
⊙ 205	64 59 57.86	9,606.95	5.969
Salters Hill	35 05 41.09	6,094.35	3.787
⊙ 208	79 54 21.05	10,436.07	6.486
⊙ 205	66 28 16.09	6,417.36	3.988
⊙ 208	52 59 01.07	5,588.67	3.473
Raber	60 32 42.84	6,094.58	3.787
⊙ 206	65 55 58.84	10,647.55	6.617
Rocky Point	42 04 12.12	7,813.50	4.855
Salters Hill	71 59 49.04	11,090.34	6.891
⊙ 206	79 51 08.58	7,744.34	4.813
Pointe aux Frênes	83 17 22.32	7,813.50	4.855
Salters Hill	16 51 29.10	2,281.56	1.418
⊙ 207	133 12 25.39	7,324.74	4.551
Raber	28 35 29.90	4,809.20	2.989
Pointe aux Frênes	18 12 04.71	3,138.95	1.951
⊙ 207	26 09 27.57	7,744.34	4.813
Pointe aux Frênes	137 57 17.63	11,764.97	7.310
Salters Hill	15 53 14.80	4,808.97	2.989
⊙ 208	79 41 16.90	7,324.74	4.551
Raber	49 46 24.66	4,862.10	3.021
Pointe aux Frênes	59 32 18.43	6,417.36	3.988
⊙ 208	53 12 05.22	7,744.34	4.813
Pointe aux Frênes	96 37 03.89	9,606.95	5.969
Salters Hill	30 10 50.90	4,862.10	3.021
⊙ 209	76 11 12.22	4,862.12	3.021
Pointe aux Frênes	25 45 40.15	2,176.11	1.352
⊙ 208	78 03 07.63	4,998.46	3.106

TABLE NO. 5.—*Tertiary triangulation, St. Marys River, etc.*—Continued.

Stations.	Adjusted angles.	Sides.	Sides.	Stations.	Adjusted angles.	Sides.	Sides.
	° ′ ″	*Metres.*	*Miles.*		° ′ ″	*Meters.*	*Miles.*
⊙ 209	88 58 09.23	5,519.36	3.430	⊙ 221	47 28 11.07	6,559.94	4.076
⊙ 208	67 48 45.25	5,111.50	3.176	Raber	24 06 04.27	3,635.05	2.259
Fort St. Joe	23 13 05.52	2,176.11	1.352	Fort St. Joe	108 25 44.66	8,445.30	5.248
⊙ 210	95 43 29.59	7,510.48	4.667	⊙ 221	138 14 50.49	9,323.32	5.792
⊙ 211	65 51 32.60	6,887.99	4.280	Fort St. Joe	26 42 22.70	6,292.18	3.909
Pointe aux Frênes	18 24 57.81	2,384.57	1.482	Drummond	15 02 46.81	3,634.60	2.259
⊙ 210	111 23 33.13	3,739.95	2.324	⊙ 222	43 45 28.45	9,934.88	6.173
⊙ 211	32 11 28.50	2,139.88	1.330	Harbor Island	16 17 03.60	4,027.95	2.503
⊙ 208	36 24 58.37	2,384.50	1.482	Burnt Point	119 57 27.95	12,445.57	7.734
⊙ 211	152 27 55.51	9,926.12	6.167	⊙ 222	22 06 50.85	6,984.59	4.340
Pointe aux Frênes	7 03 38.46	2,639.32	1.641	Bacon Island	128 14 27.32	14,572.35	9.055
Fort St. Joe	20 28 26.03	7,510.27	4.667	Drummond	29 38 41.83	9,177.10	5.702
⊙ 211	118 47 48.55	5,519.10	3.430	⊙ 223	22 22 25.90	6,559.94	4.076
⊙ 208	24 46 31.14	2,639.32	1.641	Raber	14 16 38.87	4,250.11	2.640
Fort St. Joe	36 25 40.31	3,739.84	2.324	Fort St. Joe	143 20 55.23	10,287.47	6.393
⊙ 212	122 57 00.93	2,639.35	1.641	⊙ 223	165 01 04.84	9,323.32	5.792
Fort St. Joe	33 33 38.37	1,738.78	1.080	Drummond	6 46 07.29	4,250.66	2.640
⊙ 211	23 29 20.70	1,253.63	0.778	Fort St. Joe	8 12 47.87	5,152.18	3.201
⊙ 212	60 45 30.30	3,739.96	2.324	⊙ 225	65 29 55.36	3,831.76	2.381
⊙ 211	95 18 28.20	4,267.78	2.652	Drummond	60 42 23.45	3,672.47	2.281
⊙ 208	23 56 01.50	1,738.81	1.080	Detour	53 47 41.19	3,397.84	2.110
⊙ 213	51 39 21.18	7,783.58	4.837	⊙ 225	105 28 38.11	7,783.58	4.837
Fort St. Joe	115 33 58.45	8,952.54	5.563	Detour	47 28 32.18	5,952.27	3.698
Detour	12 46 40.37	2,194.97	1.364	Fort St. Joe	27 02 49.71	3,672.55	2.281
⊙ 213	33 14 48.01	9,323.32	5.792	⊙ 227	135 36 40.61	9,323.32	5.792
Fort St. Joe	139 20 09.35	11,081.35	6.886	Fort St. Joe	15 40 07.35	3,599.59	2.237
Drummond	7 25 02.64	2,195.39	1.364	Drummond	28 43 12.04	6,404.56	3.980
⊙ 214	25 57 30.78	3,831.76	2.381	⊙ 227	121 41 44.95	8,649.82	5.375
Drummond	62 47 14.20	7,784.96	4.838	Fort St. Joe	19 15 18.38	3,352.52	2.082
Detour	91 15 15.02	8,751.79	5.438	⊙ 231	39 02 56.67	6,404.50	3.980
⊙ 214	84 54 37.22	7,783.58	4.837	⊙ 228	40 26 40.41	5,786.44	3.596
Detour	10 00 58.30	1,359.13	0.844	Bacon Island	37 56 42.79	5,484.92	3.409
Fort St. Joe	85 04 24.48	7,785.52	4.839	Burnt Point	101 36 36.80	8,737.39	5.430
⊙ 215	108 18 57.15	6,559.94	4.076	⊙ 228	25 53 56.84	2,800.67	1.740
Raber	43 15 27.14	4,735.28	2.943	⊙ 253	58 48 55.29	5,485.47	3.409
Fort St. Joe	28 25 35.71	3,289.39	2.044	Burnt Point	95 17 07.87	6,384.71	3.967
⊙ 215	60 00 20.55	14,932.76	9.280	⊙ 229	58 37 40.70	7,783.58	4.837
Salters Hill	15 56 18.88	4,734.73	2.943	Detour	77 38 10.92	8,904.90	5.533
Fort St. Joe	104 03 20.57	16,725.65	10.392	Fort St. Joe	43 44 08.38	6,302.41	3.916
⊙ 216	66 59 34.47	7,783.58	4.837	⊙ 229	76 02 18.46	8,649.82	5.375
Detour	26 51 13.22	3,819.79	2.373	⊙ 231	87 34 55.10	8,905.19	5.533
Fort St. Joe	86 09 12.31	8,434.17	4.241	Fort St. Joe	16 22 46.44	2,513.50	1.562
⊙ 216	26 29 09.16	3,831.76	2.381	⊙ 230	37 23 07.94	10,551.88	6.557
Drummond	79 05 50.74	8,436.74	5.243	Drummond	20 48 42.87	6,174.65	3.836
Detour	74 25 00.10	8,276.00	5.142	Burnt Point	121 48 09.19	14,769.57	9.178
⊙ 217	80 50 29.55	6,559.94	4.076	⊙ 230	26 10 09.60	2,800.67	1.740
Raber	42 54 07.38	4,523.32	2.811	⊙ 253	76 29 50.30	6,174.84	3.836
Fort St. Joe	56 15 23.07	5,525.23	3.433	Burnt Point	77 20 00.10	6,195.81	3.850
⊙ 218	151 31 48.04	11,361.44	7.059	⊙ 231	64 06 02.71	7,783.58	4.837
Burnt Point	24 25 40.46	9,856.34	6.124	Detour	88 32 35.35	8,649.82	5.375
Detour	4 02 31.50	1,680.01	1.044	Fort St. Joe	27 21 21.94	3,976.04	2.470
⊙ 218	15 54 28.70	2,972.81	1.847	⊙ 231	17 40 32.14	6,559.94	4.076
⊙ 235	65 19 17.82	9,855.39	6.123	Raber	23 36 09.47	8,650.54	5.375
Detour	98 46 13.48	10,719.18	6.661	Fort St. Joe	138 43 18.39	14,253.31	8.857
⊙ 219	67 28 54.07	6,559.94	4.076	⊙ 232	78 48 40.37	9,934.88	6.173
Raber	32 37 22.40	3,828.39	2.378	Harbor Island	44 13 10.98	7,062.94	4.389
Fort St. Joe	79 53 43.53	6,991.21	4.344	Burnt Point	56 58 08.65	8,490.55	5.276
⊙ 219	99 51 57.91	4,523.32	2.811	⊙ 232	74 27 22.44	10,361.45	6.438
⊙ 217	56 29 41.67	3,828.34	2.378	Harbor Island	53 24 21.52	8,634.81	5.366
Fort St. Joe	23 38 20.42	1,840.96	1.144	⊙ 218	52 08 16.04	8,490.80	5.277

TABLE NO. 5.—*Tertiary triangulation, St. Marys River, etc.*—Continued.

Stations.	Adjusted angles.	Sides.	Sides.	Stations.	Adjusted angles.	Sides.	Sides.
	° ′ ″	*Meters.*	*Miles.*		° ′ ″	*Meters.*	*Miles.*
⊙ 235	38 24 26.14	7,783.58	4.837	⊙ 273	75 07 44.28	6,155.71	3.824
Detour	127 51 43.50	9,891.49	6.146	Bacon Island	28 55 41.97	3,080.80	1.915
Fort St. Joe	13 43 50.36	2,973.85	1.847	⊙ 277	75 56 33.75	6,178.31	3.848
⊙ 245	31 26 05.05	3,831.76	2.381	⊙ 277	50 10 16.18	4,766.01	2.962
Drummond	78 03 50.93	7,188.34	4.467	Bacon Island	47 07 53.60	4,548.53	2.827
Detour	70 30 04.02	6,925.82	4.303	Harbor Island	82 41 50.22	6,155.71	3.824
⊙ 245	82 50 09.52	7,783.58	4.837	⊙ 277	30 49 33.64	9,321.19	5.791
Detour	30 46 09.30	4,013.27	2.494	Fort St. Joe	19 46 50.14	6,155.87	3.824
Fort St. Joe	66 23 41.18	7,188.41	4.467	Bacon Island	129 23 36.22	14,057.56	8.736
⊙ 247	149 44 39.35	9,321.19	5.791	⊙ 283	102 55 08.10	4,766.01	2.962
Bacon Island	16 33 45.08	5,273.42	3.276	Bacon Island	31 31 46.30	2,557.05	1.589
Fort St. Joe	13 41 35.57	4,379.34	2.721	Harbor Island	45 33 05.60	3,490.72	2.169
⊙ 247	66 46 06.53	4,863.46	3.022	⊙ 285	136 27 16.06	4,766.01	2.962
⊙ 218	94 52 40.79	5,273.42	3.276	Harbor Island	23 02 48.36	2,708.27	1.683
Fort St. Joe	18 21 12.68	1,666.53	1.035	Bacon Island	20 29 55.58	2,422.59	1.506
⊙ 253	28 06 00.87	4,766.01	2.962	⊙ 285	13 12 57.96	9,321.19	5.791
Harbor Island	17 21 25.32	3,018.63	1.875	Bacon Island	162 58 34.44	11,936.35	7.417
Bacon Island	134 32 33.81	7,211.79	4.481	Fort St. Joe	3 48 27.60	2,707.48	1.683
⊙ 253	113 50 13.51	9,321.19	5.791	⊙ 287	87 36 58.22	4,766.01	2.962
Bacon Island	48 55 55.78	7,682.91	4.775	Harbor Island	26 38 40.33	2,139.19	1.330
Fort St. Joe	17 13 50.71	3,018.63	1.875	Bacon Island	65 44 21.45	4,348.86	2.702
⊙ 261	86 51 16.30	3,018.63	1.875	⊙ 287	98 53 46.55	13,107.14	8.144
⊙ 253	44 52 58.54	2,133.34	1.326	Harbor Island	61 58 03.03	11,710.29	7.276
Bacon Island	48 15 45.16	2,255.91	1.402	Detour	19 08 10.42	4,349.04	2.703
⊙ 261	94 00 49.29	7,682.91	4.775	⊙ 291	36 03 20.12	3,018.62	1.875
Fort St. Joe	17 01 55.74	2,253.78	1.400	Bacon Island	37 41 54.47	3,136.26	1.949
⊙ 253	68 57 14.97	7,188.04	4.467	⊙ 253	106 14 45.41	4,923.95	3.059
⊙ 263	130 00 01.88	13,107.14	8.144	⊙ 291	67 56 18.18	5,804.18	3.607
Harbor Island	28 20 12.02	8,121.42	5.046	Bacon Island	60 13 56.44	5,436.34	3.379
Detour	21 39 46.10	6,316.15	3.924	⊙ 218	51 49 45.38	4,923.58	3.059
⊙ 263	20 05 00.23	4,766.01	2.962	Church spire at Detour	43 08 36.90	6,984.59	4.340
Bacon Island	152 55 48.52	6,316.18	3.924	Bacon Island	17 02 49.50	2,994.29	1.861
Harbor Island	6 59 11.25	1,688.22	1.049	Drummond	119 48 33.60	8,862.48	5.507
⊙ 267	51 12 14.98	7,783.58	4.837				
Detour	73 35 54.38	9,580.44	5.953	Smokestack at Detour Lumber Co.'s Mill	34 18 40.20	6,984.59	4.340
Fort St. Joe	55 11 50.64	8,200.43	5.095	Bacon Island	12 53 02.94	2,762.93	1.717
⊙ 267	76 37 07.19	9,321.19	5.791	Drummond	132 48 16.86	9,090.88	5.649
Fort St. Joe	12 34 26.23	2,085.84	1.297				
Bacon Island	90 48 26.58	9,580.36	5.953	Smokestack at Detour Lumber Co.'s Mill	147 01 23.36	3,831.76	2.381
⊙ 273	42 36 02.50	4,766.01	2.962	Detour	23 06 54.68	2,763.69	1.717
Bacon Island	76 03 35.57	6,833.72	4.246	Drummond	9 51 41.96	1,205.70	0.748
Harbor Island	61 20 21.93	6,178.39	3.848				

TABLE NO. 6.—*Geographical positions of the tertiary or flag stations between Sailors Encampment and Detour.*

Station.	Latitude.	Longitude.	Azimuth.	To station.	Distance.	Logarithms of distance.
	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*
The post of crib light at Ross Landing.	46 14 59.28	84 06 00.64	10 52 42.1	Rocky Point.....	7,981.23	3.9020697
			45 34 00.9	Winter Point.....	5,337.32	3.7273234
Tallest smoke-stack of the three at Sailors Encampment.	46 14 57.32	84 06 25.03	286 20 07.9	Ross.....	971.23	2.9873209
			7 12 17.2	Rocky Point.....	7,839.34	3.8942796
Iron tower, the back range light on Winter Point.	46 13 05.20	84 08 57.36	232 44 58.7	Ross.....	5,270.40	3.7218438
			332 06 26.4	Rocky Point.....	4,882.33	3.6886270
Front range light, Pilot Island.	46 10 35.09	84 07 52.88	162 21 35.3	Winter Point.....	4,637.85	3.6663170
			250 29 00.3	Rocky Point.....	956.05	2.9804829
Light-house, Round Island.	46 06 33.54	84 01 03.98	164 50 55.6	Pointe aux Frênes	2,629.71	3.4199084
			195 26 20.4	Salters Hill.....	9,891.57	3.9952650
			10 28 51.3	Raber	4,864.89	3.6870727
Sweets Point Light (post).	46 02 11.84	83 56 00.75	114 01 53.1	Raber	8,104.71	3.9087374
			167 36 46.0	Salters Hill.....	18,035.07	4.2561179
Pipe Island Light-House.	46 00 59.64	83 53 50.76	302 10 43.7	Drummond	3,123.34	3.4946186
			28 13 42.5	Detour	2,445.24	3.3883209
			145 06 27.6	Fort St. Joe.....	6,362.17	3.8036055
Frying Pan Light-House.	45 59 13.47	83 53 37.75	163 18 21.9	Salters Hill.....	24,142.75	4.3827866
			214 12 15.7	Bacon Island.....	9,569.68	3.9808972
			235 40 07.7	Drummond	2,861.57	3.4566044
⊙ 200.....	46 12 24.08	84 05 06.60	102 00 00.6	Winter Point.....	5,080.59	3.7059143
			170 28 28.0	Ross.....	4,520.70	3.6552056
			41 11 34.0	Rocky Point.....	4,047.04	3.6071378
⊙ 201.....	46 09 27.63	84 05 01.65	175 04 18.8	Ross.....	9,943.31	3.9975309
			241 41 22.5	Salters Hill.....	8,779.48	3.9434686
			142 02 14.5	Winter Point.....	8,251.31	3.9165221
⊙ 202.....	46 11 29.07	84 04 10.41	114 03 19.0	Winter Point.....	6,761.26	3.8300274
			162 24 37.8	Ross.....	6,459.21	3.8101796
			70 49 19.4	Rocky Point.....	4,098.00	3.6125723
⊙ 202 A.....	46 10 46.85	84 03 09.60	89 32 18.9	Rocky Point.....	5,175.05	3.7139149
			118 30 23.2	Winter Point.....	8,508.99	3.9298782
⊙ 203.....	46 08 47.52	84 03 29.85	137 42 57.9	Winter Point.....	10,468.68	4.0198919
			226 51 10.2	Salters Hill.....	7,896.03	3.8974086
⊙ 204.....	46 09 42.25	84 00 38.53	20 33 52.4	Pointe aux Frênes	3,512.15	3.5455736
			103 05 19.9	Rocky Point.....	8,639.50	3.9364888
			7 41 12.6	Raber.....	10,706.41	4.0296467
⊙ 205.....	46 06 50.51	84 03 06.59	275 16 43.2	⊙ 208.....	6,094.58	3.7849441
			341 44 59.3	Raber.....	5,588.67	3.7473085
			210 16 45.3	Salters Hill.....	10,436.01	4.0185371
⊙ 206.....	46 07 32.08	83 59 55.33	122 36 45.0	Rocky Point.....	11,090.34	4.0449449
			188 32 43.9	Salters Hill.....	7,813.50	3.8928458
			136 31 54.6	Pointe aux Frênes	2,281.56	3.3582326
⊙ 207.....	46 05 26.52	84 00 31.82	30 08 38.9	Raber.....	3,138.95	3.4967840
			163 21 04.3	Pointe aux Frênes	4,809.20	3.6820731
			189 30 31.9	Salters Hill.....	1,764.97	4.0705909
⊙ 208.....	46 06 32.25	83 58 24.01	175 14 27.9	Salters Hill.....	9,606.95	3.9825857
			122 02 22.7	Pointe aux Frênes	4,862.10	3.6868243
⊙ 209.....	46 05 41.54	83 59 34.36	147 47 12.1	Pointe aux Frênes	4,898.46	3.6900593
			223 58 24.4	⊙ 208.....	2,176.11	3.3376814
			312 56 33.6	Fort St. Joe.....	5,111.50	3.7085483
⊙ 210.....	46 05 35.80	83 57 26.21	33 09 09.9	⊙ 211.....	2,384.50	3.3773973
			144 32 43.0	⊙ 208.....	2,139.88	3.3303904
			128 52 32.8	Pointe aux Frênes	6,887.99	3.8380923
⊙ 211.....	46 04 31.14	83 58 26.89	180 56 57.7	⊙ 208.....	3,739.95	3.5728658
			299 44 46.2	Fort St. Joe.....	2,639.32	3.4214952
			147 16 50.7	Pointe aux Frênes.	7.510.46	3.8756666

TABLE NO. 6.—*Geographical positions of the tertiary or flag stations between Sailors Encampment and Detour*—Continued.

Station.	Latitude.	Longitude.	Azimuth.	To station.	Distance.	Logarithms of distance.
	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*
⊙ 212	46 04 24.99	83 57 06.46	96 16 23.8	⊙ 211	1,738.81	3.2402516
			157 01 54.1	⊙ 208	4,267.78	3.6302018
			333 19 22.9	Fort St. Joe	1,253.63	3.0981699
⊙ 213	46 03 57.23	83 58 21.66	90 34 18.5	Raber	4,373.86	3.6408646
			328 32 02.5	Detour	8,952.48	3.9519434
			276 52 41.3	Fort St. Joe	2,194.97	3.3414277
⊙ 214	46 03 59.16	83 55 38.85	76 16 15.6	Fort St. Joe	1,359.13	3.1332609
			351 21 38.4	Detour	7,785.52	3.8912876
			325 24 07.6	Drummond	8,751.79	3.9420967
⊙ 215	46 02 42.08	83 59 58.68	135 54 56.8	Raber	3,289.39	3.5171148
			244 13 54.0	Fort St. Joe	4,735.28	3.6753457
			184 13 32.2	Salters Hill	6,726.35	4.2234012
⊙ 216	46 04 20.32	83 53 48.46	75 12 47.4	Fort St. Joe	3,819.60	3.5820178
			341 44 03.6	Drummond	8,276.38	3.9178405
			8 13 12.8	Detour	8,436.75	3.9261742
⊙ 217	46 01 50.84	83 58 45.21	135 34 30.0	Raber	5,525.23	3.7423504
			216 24 59.6	Fort St. Joe	4,523.32	3.6554573
⊙ 218	46 05 03.79	83 53 21.32	61 33 14.5	Fort St. Joe	4,863.45	3.6869443
			299 59 56.9	Bacon Island	5,804.13	3.7637368
			218 55 58.4	Burnt Point	1,680.01	3.2253120
⊙ 219	46 01 47.80	83 57 19.72	125 18 46.5	Raber	6,991.21	3.8445525
			192 47 40.7	Fort St. Joe	3,828.39	3.5830168
			92 51 57.9	⊙ 217	1,840.96	3.2650441
⊙ 221	46 01 55.38	83 55 54.45	116 48 29.8	Raber	8,445.30	3.9266151
			164 16 40.9	Fort St. Joe	3,635.05	3.5605104
			302 31 31.4	Drummond	6,292.18	3.7988010
⊙ 222	46 07 56.55	83 52 35.73	358 54 57.2	Burnt Point	4,027.95	3.6050841
			315 09 28.6	Harbor Island	12,445.57	4.0950149
			296 28 49.5	Bacon Island	9,177.55	3.9627268
⊙ 223	46 02 21.40	83 54 07.44	107 00 21.5	Raber	10,287.47	4.0123087
			129 22 47.4	Fort St. Joe	4,250.11	3.6283998
			324 21 42.4	Drummond	5,152.51	3.7120190
⊙ 225	46 01 34.05	83 53 22.17	28 50 50.6	Detour	3,672.47	3.5649583
			323 20 55.2	Drummond	3,397.84	3.5312028
			134 19 28.7	Fort St. Joe	5,952.27	3.7746824
⊙ 227	46 00 43.49	83 54 26.20	153 15 28.8	Fort St. Joe	6,404.50	3.8064849
			274 57 13.8	⊙ 231	3,352.52	3.5253716
			288 52 09.4	Drummond	3,599.59	3.5562526
⊙ 228	46 08 11.49	83 50 05.38	35 05 43.7	Burnt Point	5,484.92	3.7391699
			354 39 03.3	Bacon Island	8,737.39	3.9413818
			9 11 46.9	⊙ 253	6,384.71	3.8051412
⊙ 229	46 01 34.94	83 50 33.36	117 40 11.6	Fort St. Joe	8,904.90	3.9496290
			58 02 30.8	Detour	6,302.41	3.7995064
			41 37 53.1	⊙ 231	2,513.50	3.4002784
⊙ 230	46 07 46.36	83 48 42.43	53 03 47.1	Burnt Point	6,174.65	3.7906125
			15 40 38.3	Drummond	14,769.57	4.1693679
⊙ 231	46 00 34.08	83 51 50.96	134 02 02.2	Fort St. Joe	8,649.85	3.9370070
			69 55 59.4	Detour	3,976.04	3.5994512
			23 30 28.6	Raber	4,252.42	4.1538887
⊙ 232	46 07 33.74	83 47 41.97	61 57 48.1	Burnt Point	7,062.94	3.8489858
			343 09 07.7	Harbor Island	8,490.54	3.9289356
⊙ 235	45 59 18.14	83 52 34.03	109 14 36.6	Detour	2,973.85	3.4733186
			147 39 02.7	Fort St. Joe	9,891.50	3.9952618
⊙ 245	46 03 37.48	83 53 34.26	94 58 28.6	Fort St. Joe	4,013.27	3.6034981
			12 08 19.1	Detour	7,188.41	3.8566331
			340 42 14.1	Drummond	6,925.81	3.8404708
⊙ 247	46 04 18.69	83 52 38.72	79 54 57.8	Fort St. Joe	5,273.51	3.7220997
			290 10 18.4	Bacon Island	4,379.27	3.6414018
			146 41 04.3	⊙ 218	1,666.53	3.2218125

TABLE NO. 6.—*Geographical positions of the tertiary or flag stations between Sailors Encampment and Detour*—Continued.

Station.	Latitude.	Azimuth.	Longitude.	To station.	Distance.	Logarithms of distance.
	° ′ ″	° ′ ″	° ′ ″		*Meters.*	*Meters.*
⊙ 253	46 04 47.37	83 50 52.85	322 33 45.7	Bacon Island	3,018.63	3.4798092
			294 27 44.9	Harbor Island	7,211.79	3.8580430
⊙ 261	46 03 34.92	83 51 06.45	274 17 50.8	Bacon Island	2,133.34	3.3290598
			187 26 34.5	⊙ 253	2,255.91	8.3533211
			93 25 35.2	Fort St. Joe	7,188.04	3.8566106
⊙ 263	46 03 11.07	83 50 41.30	40 07 18.6	Detour	8,121.42	3.9096321
			270 07 16.6	Harbor Island	6,316.15	3.8004523
			250 02 16.4	Bacon Island	1,688.22	3.2274279
⊙ 267	46 02 22.26	83 49 32.29	106 13 13.3	Fort St. Joe	9,580.44	3.9813854
			55 00 58.3	Detour	8,200.43	3.9138364
			182 50 20.5	Bacon Island	2,085.85	3.3192823
⊙ 273	46 00 11.04	83 48 53.40	173 11 21.2	Bacon Island	6,178.39	3.7908753
			215 47 23.7	Harbor Island	6,833.72	3.8346569
			248 19 03.5	⊙ 277	3,080.82	3.4886656
⊙ 277	46 00 47.88	83 46 40.32	144 17 15.0	Bacon Island	6,155.71	3.7892783
			194 27 31.2	Harbor Island	4,548.53	3.6578706
			68 26 41.2	⊙ 273	3,080.82	3.4886656
⊙ 283	46 02 19.10	83 47 20.71	128 40 38.6	Bacon Island	3,490.72	3.5429151
			231 35 46.7	Harbor Island	2,557.05	3.4077395
			136 29 26.2	Burnt Point	9,204.52	3.9640010
⊙ 285	46 03 50.01	83 47 24.90	76 38 53.7	Bacon Island	2,708.27	3.4326913
			300 11 37.6	Harbor Island	2,422.59	3.3842795
⊙ 287	46 04 28.88	83 48 35.64	31 23 36.9	Bacon Island	2,139.19	3.3302486
			303 46 38.7	Harbor Island	4,348.86	3.6383757
			93 26 52.7	Fort St. Joe	1,937.39	4.0769096
⊙ 291	46 06 09.19	83 49 26.37	00 16 42.6	Bacon Island	4,923.59	3.6922821
			68 13 00.8	⊙ 218	5,436.34	3.7353069
			36 20 02.7	⊙ 253	3,136.26	3.4964118

C.—REPORT OF MR. THOMAS RUSSELL, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., July 1, 1895.

SIR: I have the honor to make the following report on my field work for the season of 1894, and 1895 up to July 1, and the office work of computation and reduction of notes:

The angle-measuring party, consisting of myself, Mr. Elmer L. Allor, recorder, Mr. Frank D. Stevens, rodman, and Mr. Penry A. Rees, cook, took the field on August 22 at station △ 19 Hay Lake on a scow upon which a small house had been erected. A camping outfit of tents and stoves was taken along, to be used when the scow was given up.

The instrument with which I was furnished to measure angles was the Troughton & Simms theodolite No. 1, with a 14-inch horizontal circle graduated to 5′ and read by three microscopes 120° apart around the limb. The instrument, when used, is mounted on a revolving trivet so as to bring different parts of the circle into play in measuring an angle. The theodolite has a full vertical circle 12 inches in diameter graduated to 10′ and read by two opposite verniers to 10″. A small Fauth transit was used for plumbing targets and centering trivet over station mark.

At △ 19 Hay Lake the angles to be measured were those between the lines to △ Laird, □ 59 Neebish, △ Salters Hill, and to the tertiary stations △ 17, △ 18, △ 20, △ 21, △ 73, and △ 75. During the time the party was at △ 19 Hay Lake the target at △ Salters Hill was not seen. This was due to the extreme haziness of the air prevailing at the time. The distance to △ Salters Hill is 17 miles. Station △ 19 Hay Lake was left without measuring the angles to Salters Hill, in accordance with your instructions.

August 31 the scow was moved by the steamer *Myra* to □ 59 Neebish, which is close to the front range target of the Hen and Chickens Range, below the dike at the lower end of the Middle Neebish Channel. The air was very hazy a great part of the time while at □ 59 Neebish. Great difficulty was experienced in sighting to the target on △ 19 Hay Lake. This was on account of the small elevation of the line

above the water. The target was only rarely visible and was never even approximately steady, but readings were taken to it, nevertheless, as best we could. For this reason the angles observed were not entirely satisfactory, the horizon having a large closing error. This station was reoccupied October 13 to 18 and the angles reread. The target on △ 19 Hay Lake was raised 20 feet and was then always in sight, and readings were obtained to it with the air perfectly steady when the sky was clouded.

The results of the two series of angle measurements at □ 59 Neebish were as follows:

	First.			Second.	Difference.
	°	′	″	″	″
△ Laird- △ Salters Hill	106	24	41.9	40.60	+1.30
△ 19 Hay Lake - △ Laird	86	10	31.4	29.82	+1.58
△ Ross - △ 19 Hay Lake	145	25	15.0	14.51	+0.49
△ Laird- △ Ross	128	24	17.5	16.47	+1.03
Horizon	360	00	03.9	00.80	.....

September 10 the scow was towed by the *Antelope* to Ross's Dock, opposite Sailors Encampment, and the angles at △ Ross were measured by September 15.

September 16 the scow was moved by the *Antelope* to Winter Point. The camping outfit was landed and the kitchen tent set up near the light keeper's house. Here the scow was parted with regretfully, being required for the use of the topographical party.

While at Winter Point, on the invitation of Mr. Griffin, the light keeper, the party stopped at his house.

September 21 the party moved by the sailboat *Maggie* to Rocky Point, across Munuskong Bay, from Winter Point and went into camp.

Winter Point was left without seeing □ 204 and □ 206. It was afterwards ascertained that the flags at those points were not high enough to clear the curvature of the earth. Winter Point was revisited September 27, but the air was too hazy for observation. A flash, however, was seen from Mr. Allor at □ 206 on Hay Point, where he had gone to look after the target. The air continuing hazy, I came to the Sault September 28, and on returning to Winter Point October 1 neither □ 204 nor □ 206 could be seen. The flag on □ 204 was blown down by the high wind of the previous day. The flags at □ 202 A and □ 203, then recently erected, were sighted in. The flag at □ 203 was barely high enough to clear the surface of the water, only a glimpse of it being obtained occasionally.

October 3 the party moved to Pointe aux Frênes by sailboat and took quarters in a vacant house at that place. While at Pointe aux Frênes the flag stations □ 208, □ 211, and □ 203 were occupied and the necessary angles measured.

After finishing at Pointe aux Frênes the party moved by sailboat to □ 59 Neebish, and after the angles were remeasured moved to △ Raber, reaching there October 19.

The work at △ Raber was finished and the party moved by sailboat to △ Fort St. Joe October 24. While camped at △ Raber and △ Fort St. Joe Mr. Allor was away, overseeing the building of station at Detour.

October 31 the party moved by sailboat to Bacon Island. From the time of leaving Winter Point until one week after reaching Bacon Island the weather was very favorable for measuring angles over lines of moderate length. There were a good many days when the sky was clouded and the air very steady a great part of the time. The second week at Bacon Island the air, though clear, was very unsteady, preventing any very satisfactory observations.

While camped at Bacon Island □ 253 was occupied with the Fauth transit to measure one angle. The result did not prove satisfactory and the angle had to be remeasured. □ 218 was occupied with large instrument November 8.

Mr. Elmer L. Allor left the party November 9 and Mr. Arthur Beebe joined November 14 as recorder. Mr. Robert Coulson left with the sailboat *Maggie* on the 14th and Mr. Wells Church was engaged with sailboat from the 15th. Harbor Island was visited November 13 to reset a target that had been blown down.

November 15 the party left Bacon Island for Drummond Island by sailboat and meeting the *Antelope* was towed the greater part of the way.

November 23 the work at Drummond Island was finished and the next day the tug *Island Queen* came from Detour to take the party away. The wind was blowing strong and a heavy sea rolling on the shore, and it was with considerable difficulty that everything was gotten on board the tug with the aid of the sailboat. At noon, in company with Mr. Haskell's party, we started on the tug for the Sault. The high wind made it impossible to go up Mud Lake and the tug put back to Raber, remaining there for the night. A start was made early the next morning and the Sault was reached at noon November 25.

ANGLE MEASURING.

In measuring secondary angles each angle was measured separately. Ten sets of readings were made on each angle on different parts of the circle, uniformly distributed around it. The angles were measured in five different positions of the circle, the instrument being turned by means of the revolving trivet on which it was mounted for the purpose. Half the sets of readings were made with the telescope direct and the other half with the telescope reversed by lifting it from the Y's and transiting. The reading microscopes being 120° apart, this double reversing 180° in azimuth and 180° in altitude has the effect of bringing a new part of the circle into play in the direct and reversed measurements without any change in the position of the circle. Each set of readings is the mean of two measurements, one forward and one backward; that is, with the telescope turning in the direction in which the numbering of the graduation on the circle increases and the other in the reverse direction.

In tertiary angles to flag stations, light-houses, etc., only two sets of readings were usually made. The angles were not measured separately. All the objects around the horizon were read to successively, ending with a reading to the one first sighted upon. The telescope was double reversed and the objects sighted to in the reverse order. A set is the mean derived from two such series of readings.

At the secondary stations occupied four sets of vertical angles were taken to all the primary and secondary stations visible. The vertical circle of the theodolite is not movable with respect to the telescope. The horizontal line from which the altitudes are taken is determined by means of a spirit level attached to the vernier arm.

The average range in ten sets of measurements of a horizontal angle for the 54 secondary angles observed was 4.9″. The largest was 12″ and the smallest 2.5″. There are a few dents visible on the circle, indicating that it must at one time or another have received hard knocks. The smallness of the ranges shows, however, that the excellence of this fine old instrument remains unimpaired.

The run of microscopes remained nearly constant all the time in the field, except some slight changes due apparently to variations in temperature. Observations for run were made at every station occupied and a correction for run applied to every reading taken.

At every station occupied the instrument was accurately centered over the station mark in the stone underground.

The targets sighted to were made of white and black cotton cloth stretched on an iron framework guyed with iron wire. In all cases the targets were centered over the station mark. Such slight deviations from the center as were determined by means of a plumbing theodolite never exceeded a quarter of an inch; these were so small that they have been neglected in the reductions.

The average error in closing of horizon for the ten secondary stations is 0.96″, the largest being at △ Bacon Island, 2.36″, the sum of the seven angles being that much less than 360°.

The average closing error in twenty triangles is 1″, the largest being 2.94″, in the triangle △ Pointe aux Frênes to △ Winter Point to △ Salters Hill. The line △ Winter Point to △ Pointe aux Frênes is very close to the water. The instrument at Winter Point was only 7 feet above the water and the target at Pointe aux Frênes 23 feet. The line is 8.3 miles.

The following table shows the amount of field work done in the 97 days in the field in 1894.

Complete duplicate copies of all the field notes were made during the progress of the work and sent to the office.

Number of angles measured.

Station.	Secondary angles.	Tertiary angles.	Vertical angles.	Station.	Secondary angles.	Tertiary angles.	Vertical angles.
△ 19 Hay Lake	2	13	2	Raber	3	18	3
□ 59 Neebish	4	10	4	△ Fort St. Joe	6	27	6
△ Ross	5	13	6	△ Bacon Island	11	18	8
△ Winter Point	5	11	4	□ 253	.....	1	.....
△ Rocky Point	4	15	4	□ 218	.....	11	.....
△ Pointe aux Frênes	6	16	5	△ Drummond	8	20	6
□ 203	.....	3	.....				
□ 208	.....	8	.....	Total (15)	54	189	48
□ 211	.....	5	.....				

The work of setting targets and the flags for tertiary statons was in the main attended to by the station building party on the steamer *Antelope*.

EXPENSES.

The work in August and September in Hay Lake and Little Mud Lake being so closely connected with the work of channel improvement the expense was borne out of the appropriation for the 20 and 21 foot channel. During this time the cost of the party was $365.83 for salaries and $138.54 for groceries and provisions, in all $504.37. For the rest of the season—October and November—the expense of the party was paid out of the appropriation for the resurvey of the St. Marys River. During this time the cost was $739.67 for salaries and $140.60 for groceries and provisions, in all $880.27. Miscellaneous expenses, tug hire, lumber, hardware, etc., amounted to $119.74. The entire cost of the party for ninety-seven days in the field was $1,504.38.

The number of meals served in camp was 1,272. The cost of the provisions per meal was 22 cents. The cost of a meal, including the wages of cook, was 33 cents. Ten principal stations were occupied, and the cost per station was $150.44.

OFFICE WORK.

In the office, after returning from the field, all the field notes were reduced except those pertaining to the vertical angle measurements. The separate values of the horizontal angles were derived and the means taken.

Local adjustments of the angles at the ten secondary stations were made. A general adjustment was made of the primary and secondary triangulation from the line △ Larke–△ Rankin to Detour Light-House–Detour. This involved four pentagons and four quadrilaterals.

The reduction was completed of the tertiary triangulation of the St. Marys River from the line △ East Base–△ 14 Topsail Island, to the △ Line Winter Point–△ Rocky Point. The computation of the geodetic positions of the triangulation points was completed. The whole work involved 176 triangles. A considerable part of the computation of the geodetic positions was done by Assistant Engineer Glen E. Balch and Mr. Elmer L. Allor.

An adjustment was made of the latitudes, longitudes, and azimuths derived from the primary and secondary triangulation, fitting it in, to agree with the primary system, starting from △ East Base, Sault, and connecting at △ 19 Hay Lake, □ 59 Neebish and △ Rocky Point, △ Winter Point.

A computation was made of the triangle sides of the tertiary triangulation of the lower part of the river from △ Winter Point to Detour Light-House. The tertiary stations are numbered 200, 201, etc., to 293. These points are located by sighting to them from three points. The triangles locating the points are isolated side triangles and not continuous, forming a chain. These tertiary stations for the most part were not occupied by an instrument. The station numbers were identified by variously designed flags in black and white, and in measuring the angles to them the flag pole was sighted to where possible. In the case of most of the flags they were sighted at from more than the three places required. In many cases flags were sighted at from stations not intervisible. This rendered necessary the computation of numerous additional triangles from two sides and an included angle, increasing the amount of work largely in deriving the location of points. The reduction of this work involved the solution of 225 triangles.

The quadrilateral △ Pointe aux Frênes to △ Fort St. Joe to □ 208 to □ 211 was adjusted.

Other work of computation done during the year was, derivation of rectangular coordinates for all the secondary and tertiary stations below Winter Point. The geodetic positions and azimuths of a number of lines to tertiary points were derived for two magnetic stations in the vicinity of Sault.

FIELD WORK, 1895, MAY AND JUNE.

The party, composed of myself, Mr. C. Morton Ayres as recorder, Mr. Frank D. Stevens, first rodman, Mr. John Keating, second rodman, and Mr. Penry A. Rees as cook, left the Sault May 7 on the *Arthur* and landed on the 8th at life-saving station No. 10, on the south shore of Lake Superior, 43 miles west and 43 miles north of the Sault. The party went into camp at ◬ Crisp, 2 miles back from the shore.

The same instrument and the same methods were used for measuring primary and secondary angles as in 1894. For plumbing targets, centering instruments, and running topography Buff & Berger transit No. 1806 was used. A Fauth magnetometer was used in determining the magnetic declination.

◬ Crisp was occupied to measure the angles between the lines to Gargantua, 60.25 miles across the lake, to Mamainse 38 miles, Haviland 39 miles, Parisian Islands 26 miles, and Caribou Light 50 miles.

The line, Gargantua to Mamainse, is a line of the old lake survey net of triangles, and the object of the triangulation is to connect it with the Sault and Mackinac base lines.

The line from Crisp to Gargantua, it was doubtful if it could be obtained. If at all, it would only be on days of extraordinary refraction that it could be seen across. The station at Crisp was built high—99.6 feet above ground—to increase the chances of seeing. The station is well built. The interior triangular bracing of the tripod makes it so rigid there is very little tremor even in a considerable wind.

Flashing the sunlight by a mirror from Gargantua to Crisp was begun on May 14, and the light was seen at Crisp on the morning of the 16th at 7.40 and a measurement of the angle between it and Mamainse made. The light was seen again on May 27, June 3, 6 and 7; on June 6, nearly the whole time from 7 o'clock in the morning to sundown after 7 p. m. Very satisfactory measurements of the angle between Gargantua and Mamainse were obtained, the lights at both places being steady on June 6.

The axis of the instrument at ◬ Crisp in observing was 380.65 feet above the mean level of the lake from May 15 to 18. The mirror flashing to Gargantua was 386.67 feet above the level of the lake. The height of the ground at ◬ Crisp above the lake level is 279.27 feet.

Satisfactory measurements were obtained at the angles between the lines to Mamainse, Havilland, Parisian Island, and Whitefish Point. It was attempted at first to read to a target on Parisian Island, but the station is so low and on fine days is so obscured by the smoke from the constant procession of passing steamers in and out of the St. Marys River that it was not possible to see the target. A flasher was placed on the island June 27, and the same day the angle between it and Havilland was completed.

On the night of May 27, the light at Caribou Island was seen and the angle between it and Corbay Light measured. The angles to Iroquois Light, Corbay Light, Whitefish Point Light-House, and a smokestack at Deer Park were measured.

The weather while at ◬ Crisp was exceedingly unfavorable for observation over long lines all the time from May 8 to July 1. The air was hazy or foggy nearly all the time, preventing seeing over more than a few miles. The only good weather for observing was in the calm after the prevalence of a northwest wind.

A line of levels and a double stadia line was run from ◬ Crisp to the shore of Lake Superior and 1 mile of shore line was done on each side of life-saving station No. 10.

The magnetic declination was observed on a number of days. The mean for four days, June 21 to 25, gives the azimuth of magnetic meridian 179° 44.6′, that is, the needle points 15.4′ west of north.

The magnetic station is 163 meters north of ◬ Crisp in azimuth 179° 34′ 14″.

◬ Crisp is located in the eastern part of Luce County, Mich., in sec. 13, T. 50 N., R. 8 W. The station is 531 meters east and 982 meters south of the section corner 11, 12, 13, 14.

◬ Crisp is marked by a triangle of copper half an inch on a side leaded into the top of a stone 2 feet long, squared 6 inches at the top, and placed with the top surface 2½ feet below the surface of the ground. The surface mark is a nail in 6-inch cedar post embedded in the ground above the marking stone. Three surface stones are placed each 100 feet from the station center in azimuths 120° apart, the one to the north being in the meridian with the station.

Special thanks are due to Capt. R. M. Small of life-saving station No. 10, for courtesies extended to the party while at ◬ Crisp, for assistance rendered to the prosecution of the work and landing mail and provisions from steamer.

Very respectfully, your obedient servant,

THOMAS RUSSELL, *Assistant Engineer.*

First Lieut. CHARLES S. RICHÉ,
Corps of Engineers, U. S. Army.

D.—REPORT OF MR. THOMAS RUSSELL, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., June 30, 1890.

SIR: I have the honor to make the following report on the adjusted latitudes, longitudes, and azimuths derived from the tertiary triangulation of the St. Marys River, extending from the line △ East Base to △ 14, just above Little Rapids, to the line △ Rocky Point to △ Winter Point, across the entrance to Munuskong Bay and extending through Hay Lake, Lake George, the West Neebish, the Middle Neebish, Little Mud Lake, and Munuskong Bay:

The tertiary and secondary systems of triangulation over this region have in common the station △ 19 Hay Lake, □ 59 Neebish, △ Winter Point, and △ Rocky Point.

The length of the line △ Rocky Point to △ Winter Point as derived from the secondary and tertiary triangulation is as follows: 4,704.610 meters by the secondary,

4,703.753 by the tertiary through Lake George and Little Mud Lake, and 4,704.980 by the tertitary through Hay Lake and the West Neebish.

The geodetic latitudes, longitudes, and azimuth were computed by means of the observed angles with corrections applied to make the triangles close to 180°. The computations were made by means of the Coast and Geodetic Survey tables given in appendix No. 7 of the Report for 1884; the tables are based on the Clarke spheroid as the figure of the earth. In the reductions no account was taken of the spherical excess in the triangles; it does not amount to more than 0.01″ in the case of most of the triangles.

The initial point from which the latitudes and longitudes are computed is station △ East Base, Sault Ste. Marie, and the initial azimuth is that of the line △ East Base to △ 14. The latitude, longitude, and azimuth used at △ East Base are those derived by the secondary triangulation from the values determined astronomically at the Sault Ste. Marie Observatory, west pier, namely:

Observatory, west pier, Sault Ste. Marie, latitude, 46° 30′ 6.270″; longitude, 84° 20′ 48.750″, and the azimuth at observatory, west pier, to △ azimuth is 178° 6′ 38.87″, reckoned from the south through the west toward the north.

The secondary and tertiary determinations of the geodetic latitudes, longitudes, and azimuths at the common stations are as follows:

	Latitude.			Longitude.		
	Tertiary.	Secondary.	Difference.	Tertiary.	Secondary.	Difference.
	° ′ ″	° ′ ″	″	° ′ ″	° ′ ″	″
△ 19 Hay Lake	46 22 02.897	46 22 2.892	—0.005	84 13 59.065	84 13 59.118	+0.053
△ Winter Point	46 12 58.281	46 12 58.229	—0.052	84 08 58.347	84 8 58.451	+0.104
△ Rocky Point	46 10 45.474	46 10 45.432	—0.042	84 07 10.754	84 7 10.867	+0.114
□ 59 Neebish	46 18 40.907	46 18 40.862	—0.045	84 07 32.552	84 7 32.565	+0.012
Lake George Light-House	46 24 39.812	46 24 39.794	—0.018	84 08 47.157	84 8 47.142	—0.015

	Azimuth.		
	Tertiary.	Secondary.	Difference.
	° ′ ″	° ′ ″	″
△ 19 Hay Lake to △ 18	192 33 39.63	192 34 02.70	+23.07
△ Rocky Point to △ Winter Point	150 38 38.98	150 38 58.09	+19.11
□ 59 Neebish to △ 55	218 38 44.50	218 38 38.00	+13.50

The latitudes and longitudes of the tertiary points are adjusted by applying as corrections a part of the discrepancy as shown at the secondary stations, proportional to the differences between the latitudes and longitudes of the place and those of the secondary stations.

The differences between the secondary and tertiary locations of △ 19 Hay Lake in latitude and longitude are —0.005″ and +0.053″. Proportional parts of these are applied to the locations of all the stations from △ East base through Hay Lake to △ 19 Hay Lake, where the corrections to the tertiary location of this station equal the whole amounts of the differences.

At △ Rocky Point the differences between the tertiary and secondary locations are —0.042″ in latitude and +0.114″ in longitude. To all the stations from △ 19 to Hay Lake through the West Neebish to △ Rocky Point, the corrections vary according to the difference in latitude and longitude from △ 19 Hay Lake.

The latitudes and longitudes of stations from △ East Base through Lake George to □ 59 Neebish were adjusted by applying as corrections a part of the discrepancy shown at □ 59 Neebish —0.045″ in latitude and +0.012″ in longitude, taken in proportion to the difference in latitnde and longitude of the station from △ East Base.

The latitudes and longitnides of intermediate points from □ 59 Neebish to △ Rocky Point through Little Mud Lake, and from □ 59 Neebish through the Middle Neebish to △ 73 on Hay Lake were adjusted by applying corrections varying according to the latitude and longitude, and in accordance with the discrepancies shown at the terminal points.

The discrepancies between the secondary and tertiary azimuths are +23.07″ on the line △ 19 Hay Lake to △ 18; +13.5″ on the line □ 59 Neebish △ 55; +19.98″ in the line △ Rocky Point to △ Winter Point in going down through the West Neebish; and +0.95″ on the line △ Rocky Point △ Winter Point in going down Little Mud Lake.

The tertiary azimuths from △ East Base-△ 14 through Hay Lake to △ 19 Hay Lake-△ 18 were adjusted by applying as corrections parts of the discrepancy as shown at △ 19 Hay Lake, taken in proportion to the number of triangles from the line △ East Base-△ 14. The number of triangles in the stretch is 21. A correction of 1.10″ is applied to the angles opposite each flank side, alternately plus and minus on opposite sides of the chain. The flank side is the side which is neither the base line nor the continuing or common side of the next succeeding triangle.

The process of adjusting the azimuth disturbs the closing of the triangle and in order to rectify it, half the amount added to or subtracted from the angle opposite the flank side is applied with the opposite sign to each of the other angles.

Between the line △ 19 Hay Lake to △ 18, where the azimuth discrepancy is +23.07″, and the line △ Rocky Point to △ Winter Point through the West Neebish, where the discrepancy is +19.11″, the change in correction 3.96″ is distributed among 31 triangles, making the correction to each angle opposite the flank side +0.13″ in this stretch.

In the chain of triangles from the line △ East Base to △ 14 to the line □ 59 Neebish to △ 55 by way of Lake George, there are 37 triangles and the discrepancy in azimuth +13.5″ on the line □ 59 Neebish to △ 55 introduces a correction in each triangle of 0.365″.

In the chain of triangles from the line □ 59 Neebish to △ 55, where the discrepancy is +13.5″ to the line △ Rocky Point-△ Winter Point through Little Mud Lake, where the discrepancy is +0.95″, the change 12.55″ is distributed among 16 triangles, introducing a correction in each one of 0.78″.

In the chain of triangles through the Middle Neebish from the line □ 59 Neebish to △ 55 where the azimuth discrepancy is +13.5″ to the line △ 75-△ 76 at the foot of Hay Lake, where the discrepancy is +4.69″, the change 8.63″ is distributed among ten triangles, making the correction to each 0.86″.

In addition to the chains of triangles enumerated, there are 55 additional triangles not forming part of the chain for which the azimuths of the sides have been adjusted. The correction applied to the azimuths of the sides in each triangle are the same as the correction to the side which the triangle has in common with the chain.

The locations of four stations, □ 15, □ 9, □ 11, and □ 4, on the St. Marys River, above △ East Base, Sault Ste. Marie, are given here for completeness.

In Table No. 3 the adjusted angles of the triangles and the lengths of the sides in meters are given from the side △ East Base to △ 14 to the side △ Rocky Point to △ Winter Point through Hay Lake and the West Neebish, through Lake George and the Middle Neebish, and through Little Mud Lake.

In Table No. 4 are given the adjusted latitudes and longitudes of the tertiary triangulation points, the adjusted azimuths of the lines, the lengths of the lines in meters and miles, and the logarithm of the lines in meters.

△ 89 R, on the West Neebish, was occupied in 1894, and supplied the place of the old station △ 89, washed away.

Stations □ 10 R, □ 12 R, □ 34 R, △ 46 R, and △ 49 are stations on Lake George located for the hydrographic work to supply the places of the old stations of the same number which could not be discovered.

Very respectfully, your obedient servant,

THOMAS RUSSELL,
Assistant Engineer.

First Lieut. CHARLES S. RICHÉ,
Corps of Engineers, U. S. A.

E.—REPORT OF MR. H. VON SCHON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., June 30, 1895.

SIR: I have the honor to respectfully submit herewith my annual report covering the fiscal year from July 1, 1894, to June 30, 1895, consisting of:

Part I. Field operations during 1894.
Part II. Field operations during 1895.
Part III. Office work during fiscal year.
Part IV. Recommendations.
Appendix—General instructions to chiefs of topographical parties.*
Appendix—Photogrammetry.

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* Not forwarded.

PART I.

FIELD OPERATIONS DURING 1894.

Synopsis.—The topographical survey of the upper reach of the St. Marys River—from Point Iroquois to Little Rapids—designated by project chart No. 3, having been completed during the season of 1893, the programme for the topographical field operations during the season of 1894 was chart No. 2, covering the reach from Little Rapids to Mud Lake.

A topographical field party was organized and took the field on September 17, 1894, and began the survey at the Little Rapids, proceeding east to Little Lake George until about October 1, 1894, when by your direction the programme was changed and the survey carried from Little Rapids south along Hay Lake.

The party continued in the field under my charge until November 30, 1894, completing the topographical survey of Hay Lake, including all the approaches thereto from West Neebish, Middle Neebish, East Neebish, Little Mud Lake, and Collingwood Channel.

The character of this country differs materially from that of the upper reach of St. Marys River in that a large part of it is well settled and developed. The shore along Hay Lake on both sides is almost wholly low and sandy. On the Peninsula side the land back of the shore is level or gently rolling. Several water courses empty into Hay Lake from this side, the most prominent among them being Charlotte River, which is navigable for light-draft boats for about 2 miles from its mouth. Several good roads parallel the shore on this side of Hay Lake and others lead from the interior to the shore. The country along Hay Lake shore is well settled and much of the land cleared and cultivated. The Sugar Island shore rises gently from the water's edge to a hill range paralleling the shore within half a mile distance from it as far south as Nine Mile Point, and with a maximum elevation of about 780 feet above mean tide, New York, or about 200 feet above Hay Lake level. Some roads lead to shore from the interior of Sugar Island, but no road parallels the shore.

Narrative.—The topographical party as organized consisted of Recorders John P. Conrick and Andrew J. Swift, Rodmen H. Ohlschlager, C. E. Thompson, G. P. Tucker, W. J. Steere, E. N. Church, and C. W. Given, and 2 axmen and 1 cook, which personnel remained unchanged during the continuance of the party in the field, all of the members proving capable and faithful in the performance of the duties respectively allotted to them.

The equipment of the party consisted of 2 plane tables, B. & B.; 1 transit, B. & B., No. 245; 1 transit, H. & B.; 1 level, Gurley; 2 prismatic compasses, 2 Locke levels, and the necessary complement of stadia rods, level rods, small boats, and tools.

A small rock scow belonging to the operating and care department of the St. Marys Falls Canal, and not in service, was secured for temporary use, and a house 12 by 18 feet erected thereon and occupied as kitchen and drafting office.

The party went into camp at Cook Island, old channel, on September 17, 1894, and thence operated from Little Rapids west to about Brassar Point. On October 4 the camp was moved to Pleasant Park Island and the survey continued from Little Rapids south into Hay Lake, and was thence carried along the shores of Hay Lake, with camps at Povey's Dock, October 15 to November 1, 1894; at Sailors Creek, November 2 to November 11; at Middle Neebish, November 12 to November 25; at A. Rain's Dock from November 26 to November 30, 1894. By this time the river became seriously obstructed by floating ice, and the topographical survey was therefore brought to a close for the season.

Methods.—The general plan of the topographical survey was as follows: Reconnoiterers equipped with compass and hand level first traversed the country to secure a general knowledge of the character of the topography and of the detail requiring location. From the information thus gained the instrumental field programme was made up. Plane-table sheets having been prepared with polyconic projection of minutes of latitudes and longitudes, and all triangulation stations and bench marks platted thereon from geographic coordinates, a precise survey was made of the shore line by plane table based and oriented on these platted reference points. All aids to navigation were accurately located by intersection from three points and all shore-line details located by stadia readings and alidade pointings. The territory back from shore was entered into by precise azimuth transit lines based on and checked by ties to azimuths between triangulation stations, and topographical details along these transit lines were located by plane-table surveys operating from these established transit points. Twenty-foot contours were located by vertical arc readings, elevations being referred to and checked on water level, plane of reference for same being found from established bench marks and water-gauge readings. For territory from which established triangulation stations were inaccessible, supplemental triangulation stations were established by triangulation from the regular shore system, and elevations of such points—generally on crest of hill ranges—were found by readings of zenith distances. In this manner the entire terri-

tory was covered by a network of lines located instrumentally, always beginning and terminating at some point being a link of the continuous triangulation system. The terrene between these lines was traversed by transit, plane-table, or compass surveys, or by instrumental reconnaissance, as the existence or absence of important or unimportant topographical details seemed to render one of these different methods the most suitable for the accurate and economic carrying forward of the survey. For a full description of the specific methods employed in detail in each of the different instrumental operations, as well as for the rules and practices which were followed in the administrative and executive work of the survey, I have the honor to respectfully refer to appendix * entitled "General instructions to chiefs of topographical parties," and which is hereby attached as a part of this report.

All field operations were recorded in detail in field record books Nos. 1 to 14, topographical survey, 1894, and which are on file at the U. S. Engineer Office at Sault Ste. Marie, Mich., and all topography located was reduced and platted on a scale of 1:10000 on eight field sheets, and compiled on same scale on record sheets Nos. 10, 11, 12, and 13, which are also on file at the U. S. Engineer Office at Sault Ste. Marie, Mich., and blue-print copies of which have been forwarded to Col. O. M. Poe, Corps of Engineers, U. S. A., at Detroit, Mich.

Results.—The topographical party was in the field from September 17 to November 30, 1894, of which time fifty-one days were actually devoted to field work. During this time 796 stations were occupied by instruments, namely, 3 secondary triangulation stations, 51 tertiary triangulation stations, 15 supplemental triangulation stations, 430 transit stations, 274 plane-table stations, and 23 compass stations.

The instrumental field work resulted in the location of about 69.5 miles of shore line, together with all shore details of natural or artificial origin; all aids to navigation, rocks above and below water, rock shoals and islands; of about 3 miles of the Canadian Pacific Railway, Algoma branch; of about 46 miles of roads, together with all details of houses, fences, bridges, etc.; of about 5.5 miles of inland water courses; of about 19 miles of hill ranges, in contours of 20 feet, reduced to plane of reference of mean tide, New York, and with a maximum elevation of about 780 feet above mean tide, New York; and about 20.5 miles were chopped through timber or brush for the purpose of traversing by instrumental surveys, and about 21 miles of lines through territory deemed of insufficient importance for other instrumental operations were covered by instrumental reconnaissance.

All the conditions of the ground and the character of the timber were noted and platted on the entire territory surveyed.

About 52.07 square miles of territory were thus topographically surveyed during the season of 1894.

FINANCIAL STATEMENT.

The cost of the 1894 topographical survey is made up of—

Salaries paid to members of topographical party	$1,821.64
Subsistence of topographical party	564.71
20 per cent of cost of instrument equipment (20 per cent having been charged against survey of 1893)	61.00
50 per cent of camp equipment (50 per cent having been charged against survey of 1893)	286.63
Transportation of party and members	50.00
Total cost of survey	2,783.98
Cost per square mile $\frac{2,783.98}{52.07}$ =	53.28
The mean cost per square mile of topographical survey of 1893 was	59.97

PART II.

FIELD OPERATIONS DURING 1895.

The topographical party for the present season was organized on May 6, c. s. consisting of Recorders John P. Conrick, Andrew J. Swift, and Howard N. Eavenson, Rodmen C. E. Thompson, W. J. Steere, Murray Blanchard, Martin J. McNeeley, and A. D. Trempe, and 1 cook, 3 axmen, and 1 laborer.

The Government steam tug *Myra* was attached to the party, and the scow house used during the season of 1894 was again taken out, being fitted this season entirely for a drafting office.

The party was equipped instrumentally with the same outfit as during the season of 1894.

The programme for this season's field operations is the unsurveyed portion of chart No. 2, beginning at about Brassar Point, on the old channel, and progressing through

* Not forwarded.

Lake George to northern limit of last season's survey, in East Neebish Channel, and thence southerly toward Mud Lake.

The end of the fiscal year finds the survey completed to about the latitude of "The Elbow," in Lake George.

The character of the territory so far has been much the same as the territory surveyed during 1894 and heretofore described, with the addition of the quite prominent Garden River and Echo Bay hill ranges, which rise abruptly and much broken a short distance from the river shore to a mean elevation of about 1,000 feet above mean tide, New York, or about 425 feet above the level of St. Marys River, with a maximum elevation located of about 1,060 above mean tide, New York, or about 480 feet above the level of St. Marys River.

This formation is mainly of a slate conglomerate, with some red and white quartzite and some marble. Some red and white sandstone has been located on the Sugar Island shore of Lake George about a mile south of Church Point. Root River, Garden River, Echo River, and Bar River are the most important tributaries of the St. Marys River on this reach, all of them emptying into it from the Canadian side and being water courses of considerable volume and navigable for light-draft boats for from 2 to 5 miles up. Good roads follow the Canadian shore of St. Marys River on this reach, and several lead to the shore from the interior on both sides of the river. Both shores are chiefly sandy, and the country abutting the river is well settled all along. The Indian settlements of French Bay and Garden River, with about 500 inhabitants, are located along the north shore of Little Lake George and at the mouth of Garden River.

The topographical party went into camp at McMahon's Dock on May 6 and moved to Shields's Dock on May 20.

Up to the close of the fiscal year the party had been in the field fifty-six days, of which forty-four and one-half days had been actually devoted to instrumental field work. During this time 833 stations were occupied for instrumental operations, namely, 1 secondary triangulation station, 35 tertiary triangulation stations, 11 supplemental triangulation stations, 92 transit stations, 631 plane-table stations, 63 compass stations, and the field work has resulted in the location of about 40 miles of shore line, 13 5 miles of Canadian Pacific Railway, 47.6 miles of roads, 18 miles of interior water courses, 24.8 miles of hill ranges in 20-foot contours, and about 21.4 miles were cut through timber or brush for the purpose of instrumental surveys; about 7.5 miles of lines were traversed by instrumental reconnaissance, not being deemed of sufficient importance for other instrumental operations.

A total of about 48.67 square miles of territory has been in this manner topographically surveyed this season.

The general plan of this survey and the methods of detail operations followed have been the same as those described heretofore in connection with the 1894 survey and as fully given in Appendix,* with the exception that more prominence has been given to the plane table and that the transit work has been reduced correspondingly, being resorted to only when territory had to be entered which was too distant from shore to be economically connected by supplemental triangulation with the tertiary system and for the purpose of tying to the eastern limit of the 1894 survey across Sugar Island.

The records of all instrumental operations have been kept in field record books Nos. 1 to 18, topographical survey of 1895, which are all on file at the office of the survey in the field; and all topography located has been reduced and platted on a scale of 1:10000 on 14 plane-table sheets and 11 reconnaissance sheets, the latter containing in addition to the plats of the instrumental reconnaissance also the result of the general reconnaissance made before entering on the territory with instruments, all of these being on file at the office in the field.

HYDROGRAPHIC FIELD WORK.

In addition to the topographical survey the following hydrographic field work has been done by the party under my charge during this season:

The area between the islands just south of Little Rapids was sounded, open water having prevented its being sounded through the ice during the past winter. The work was done with sounding poles from boats being rowed over fixed ranges, the time of start and finish being recorded. About 800 soundings were made. The entire reach of St. Marys River covered by chart No. 3 was sounded for river-bed characteristics. This work was done by throwing the lead from the tug *Myra*, running on fixed ranges, time of start and finish being recorded. About 75 miles of lines were sounded in this way, the soundings being made at intervals of about 30 seconds.

The buoys set at the opening of this season's navigation from Point Iroquois to the Hay Lake Channel were located by angle readings from 3 points for each buoy; 3 can buoys and 23 spar buoys were read in in this manner.

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* Not forwarded.

FINANCIAL STATEMENT.

The cost of this season's field work to the close of the fiscal year is made up of—	
Salaries paid to members of topographical party	$1,854.25
Salaries paid to tug crew	275.00
Subsistence of topographical party and tug crew	472.04
Twenty-five per cent of new equipment and repairs to old, the period now reported on being about one-fourth of the probable season	32.90
Fuel for tug to close of fiscal year	89.19
Total cost	2,723.38
Of this amount the hydrographic field work is charged with	281.50
Total cost of topographical survey to close of fiscal year	2,441.88
Cost per square mile of topography this season	50.18
Cost per square mile of topography during 1894	53.28
Cost per square mile of topography during 1893	59.97

PART III.

OFFICE WORK.

The office work under my charge during the fiscal year covered by this report has consisted of—

Topographical drafting, comprising the entire completion of the finished topography on record sheets Nos. 1 to 9, making up chart No. 3, St. Marys River, which have been submitted to Col. O. M. Poe, Corps of Engineers, Detroit Mich.; and of—

Hydrographic drafting, comprising the platting of nearly all the soundings made by the ice survey of 1895, under the charge of Assistant Engineer Joseph Ripley. About 128,000 separate soundings were plotted on 56 separate sheets distributed over 23 sounding areas and covering St. Marys River from Point Iroquois to south end of Lime Island, being an area of about 160 square miles. These soundings were platted on a scale of 1:5000 from the original field records, corrected to proper plane of reference for each area, on projections of the area sounding-line schemes by the coordinated section intersections. All of these plats are on file at the United States Engineer Office at Sault Ste. Marie, Mich., and blue-print copies of the same were submitted to Col. O. M. Poe, Corps of Engineers, U. S. A., Detroit, Mich.

I was assisted in this work by Recorders John P. Conrick and Andrew J. Swift, and for a period during the month of April, 1895, by Recorder Howard N. Eavenson and Inspector J. H. Sawyer.

All of these sounding plats were reduced by me to submarine contours for every 3 feet up to 30 feet, and these contours were reduced to a scale of 1:10000 and transferred to the record sheets Nos. 1 to 9.

The result of the river-bed soundings and the buoys read in were also platted on these record sheets.

The total cost of the platting of ice soundings as completed to date has been about $707, being a cost per square mile of ice soundings platted of $4.36.

PART IV.

RECOMMENDATIONS.

The organization of the topographical party as constituted this season is, in my judgment, the most suitable and economic one for this particular survey in this part of the country, and I respectfully recommend that the same be continued for the completion of the resurvey of the St. Marys River; and as the satisfactory progress depends chiefly upon the experience of the personnel comprising the party, I have the honor to respectfully recommend that salaries of recorders and rodmen reengaged for season of 1896 be increased about 10 per cent.

The present instrumental equipment is very complete for all purposes required in this work, and with some slight repairs and additions will no doubt prove sufficient to the end of the survey. The two plane tables purchased in 1893, and now in use for the third season, are beginning to show wear in some essential parts, namely, the table clamp and tangent, and the table itself. The first defect, I believe, can be eradicated by separating the clamp from the tangent, that is, placing a clamp only on one side of the horizontal plate, and the tangent movement at a point of the plate about 180° from the clamp. Under the present arrangement, clamp and tangent being combined, the excessive pressure of the clamp screw required to tightly bind the heavy metal plates also partially binds the socket in which the tangent screw moves, and thus renders it almost entirely useless for the intended purpose, as its movement is heavy and jerky. The apparent defect in the table proper consists in

its not being rigid and firm enough to retain a position sufficiently level for the carrying of elevations by means of alidade, striding level, and vertical arc. The outer parts of the table will yield under the weight of the alidade when moved about. This I believe can be corrected by adding to the present three arms supporting the table metal extension ribs of suitable shape and about 6 inches long and bolted to the present table supports. This would extend the rigid support to the extreme edges of the table and probably make it firm enough for the purposes required, while the extension arms would not interfere with any other movement of the table. The danger of breaking these extension arms during transportation of plane table when dismantled could be easily avoided by unbolting and removing them temporarily. I have the honor to respectfully recommend that these alterations on the two plane tables be authorized.

The importance of instrumental reconnaissance in connection with this survey suggests some betterment in the equipment for that class of work. The prismatic compasses now being used are slow and frequently unreliable. A liquid hand compass would, I believe, be the most suitable instrument for this purpose. The value of this work would furthermore be greatly enhanced if reconnoiterers were equipped with pedometers for a better record of distances traversed by them, and I respectfully recommend that two liquid hand compasses and two pedometers be procured for this purpose.

Very respectfully, your obedient servant,

H. VON SCHON,
Assistant Engineer.

First Lieut. CHARLES S. RICHÉ,
Corps of Engineers, U. S. A.

APPENDIX.

PHOTOGRAMMETRY.

In my annual report of June 30, 1894, I had the honor to submit, in accordance with your request, a brief sketch on the recent introduction of phototopographic methods as practiced by European governments, which was compiled by me from German and French publications on the subject. Since then I have given considerable time to further acquaint myself, not only with the theory of photogrammetry from foreign literature, but also with the practical application of this method by personal experiments and operations.

After a thorough examination of the literature treating on photogrammetry in anything like such completeness of detail as one desirous of practicing it successfully would require, I find that the book of Dipl. Eng. Fredrich Steiner, of Prag, published by R. Lechner, of Vienna, in 1893, is probably the best and most complete one on the subject, though much valuable information can be culled out of a number of other works treating on photogrammetry such as: Memoires sul l'application de la Photographie al lever des Plans, by M. Laussedat, 1864; Photogrammetry, by G. Koppe, Weimer, 1889; La Fotographia in Italia, by L. P. Paganini, 1889; Photogrammetry in the Italian Alps, by Dr. Finsterwalder, Munchen, 1890, and by the same author, Topography by Means of Photogrammetry, Munchen, 1891; Photogrammetry, by Fr. Schiffner, Halle, 1890; Photogrammetry in the Bavarian-Austrian Boundary Mountains, by V. Pollock, Berlin, 1893, and from several other publications on the subject.

For the purpose of making personal practical tests of the application of the theory gathered from above mentioned sources, I had constructed for me such an apparatus as I had decided to be the most suitable one for the most general applications of the method, following in the main the style and construction of the apparatus used since 1887 in the survey of the Canadian Rocky Mountain territory carried on by the Dominion Government under the immediate charge of Surveyor-General E. Deville and executed entirely by photogrammetry. From the reports of this survey, for which I am indebted to Mr. E. Deville, it appears that the survey was begun in 1887, the operating force consisting of one phototopographer, one assistant reading angles, and two packers, and that the annual progress of this survey has grown from about 120 square miles during the first year to about 500 square miles during the last year covered by the report, and that the cost of the survey (I presume for field work only) has been about $7.50 per square mile. The survey is being mapped on a scale of 1 : 60,000 in colored charts. Mr. Deville very kindly sent me the photographs of the angle-reading instruments, Troughton & Simms theodolite, and of the photoapparatus constructed by Dahlmeyer, of London, England.

The photoapparatus I had constructed consists of a plain, strong walnut box in dimensions suited for 5 by 7 plates, the back part of the camera being so constructed

as to receive in a tightly fitting frame a 5 by 7 plate holder of the Zephyr type, which can be inserted or removed readily without the application of springs, slides, or screws, and without in the least jarring the camera. Such a plate holder with its central portion removed serves me also as the ground-glass frame, the focusing glass itself, when in position, occupying the exact place which is taken up by the sensitive plate during exposure. The objective, which is the same as used in European photogrammeters and in the apparatus employed by the Canadian Government, namely a Zeiss anastigmat, wide angle ser. V No. 4. $\frac{f}{1}$, is secured to a shield being part of an interior sliding box frame, and to which is fixed a tangent-screw movement with a firm mechanical stop at that position which marks the universal focal distance of the objective from the ground glass. A tangent movement has been merely added to render the camera applicable for other than distant-view work, namely, copying, etc. The objective is fitted with a Bausch & Lomb diaphragm shutter, allowing of mechanically accurate exposures from one one-hundredth of a second to three seconds with any stop from $\frac{f}{18}$ to $\frac{f}{90}$; back of the objective is fixed a frame in which is placed a deep orange-colored glass screen. The camera frame is about 4 inches longer than the size required for focal length, and both ends of camera are closed by hinged covers during transportation. Three screw plates are fixed on two sides of the camera, to which a metal plate, with spindle, fitting to the socket of a Gurley level head, is screwed when the camera is mounted. Two ordinary levels are placed on adjoining sides of the camera.

When operating, the spindle plate is screwed on camera and set in Gurley level head on the regular level tripod, and this apparatus can then be plumbed over a specific point, can be precisely leveled, and has a horizontal tangent motion and clamp.

The essential instrumental constants for photogrammetry work are—

1. The vertical position of the plate.
2. A main horizon and vertical which must appear on the ground glass intersecting in the focal plane and which must also appear by distinct marks on the four edges of the exposed and developed plate.
3. The precise value of the focal distance from focal point of the objective to the sensitized surface of the plate.

The adjustment of the camera levels secures the vertical position of the plate; the main horizon was found and projected by me on the ground glass by aid of a level; the main vertical was fixed by setting a point, "A," at a distance from camera = 30.48 meters, and from this two other points, "B" and "C," each 13.41 meters from "A" and at right angles to line from "A" to "O," point occupied by camera, and by then so adjusting the camera that the images of the points "B" and "C" were exactly equidistant from the image of point "A" on the ground glass. In this position the camera was firmly clamped and the vertical projected through the image of "A" and perpendicular to the main horizon. The precise value of the focal distance, with the objective at universal focal-length position, was found by accurately measuring the distance image of "A" and "B" on ground glass, and being found = 0.0788 meters, then *a*, *b*, and *c*, standing for the images of A, B, and C, and *f* for O*a* or focal distance.

$$Oa : OA = ab : AB \text{ or } f = \frac{30.48 \times 0.0788}{13.41} = 0.1789 \text{ meters.}$$

The point O occupied by camera, and from which the measurement to A = 30.48 *m.* was made, not being precisely under focal point of the objective, the necessary reduction for point projected from the focal point was made.

The main horizon and vertical were projected on the ground glass by fine lines, and small metal pointers were so fixed in the plate-holder frame of the camera as to exactly coincide with the lines on the ground glass and sufficiently protruding from the frame toward the center that the extreme points would be indicated on the four margins of each plate exposed in the camera.

With instrument constants thus adjusted I took several trial negatives of distant views with different plates and found that a slow isochromatic gelatino-bromide plate, exposed behind a deep orange-colored glass screen, gave the best results as to detail in distance. The standard pyro-potash developer secured satisfactory density.

The reach of the St. Marys River from Little Lake George to Churchville Point, a distance of about 3½ miles, was selected as the subject of my first survey by photogrammetry, this reach offering the advantage of presenting in a compact territory all the most characteristic topographical features of this region. The river itself is narrow on this part, varying from 250 to 1,000 meters; the southern—American—shore rises gently to a uniform hill range about 150 feet above the river, while the northern—Canadian—shore is level for about one-half mile and then abruptly rises up to a prominent and much broken formation of a mean elevation of over 400 feet above the river,

and in some places culminating in isolated caps 500 feet high. A commanding and unobstructed view can be had from several points of the major portion of the opposite shore and back country.

My method of operations was as follows:

A suitable operating point having been decided upon on the crest of the ridge and a surface mark set, the camera was set over it, plumbed and leveled. The main vertical was adjusted on some prominent feature in the landscape, such as a church steeple, house gable or prominent tree on the opposite hill range, and in that position was permanently clamped. An exposure was then made, and after removal of the plate holder the pointing of the main vertical was checked. The camera was then removed and a transit set over the operating point. Horizontal angles were read to three prominent points on opposite shore near the water's edge, previously flagged; one zenith-distance reading was made to water level, and horizontal angle between the next operating point and main vertical pointing was read. By these angle measurements the orientation of the operation point and the orientation of the plate taken was secured. The operating point was then flagged and the next point occupied. Three operating points were occupied on each side of river; eight plates were taken from them; four shore points on each side were used for reference points. The field operations were completed in one day. The topographical survey of this identical region occupied two instrument parties of four men each about twelve days.

The plotting of the topography secured by the photogrammeter is done either by the graphic method or by projection from rectangular ordinates taken from negative or positive. The latter method is the longer but the most accurate one, while the graphic method is no longer than the plotting of an ordinary transit survey and yields fully as accurate results provided the representation of the territory on the plate is distinct enough to allow of the easy identification of similar points. For this method the base between two operating points is reproduced to desired scale, and from each operating point the main vertical of the respective view is projected according to the angle measured, and at a distance equal to the focal distance from operating point, a line representing the image plane is drawn at right angles to the projected main vertical. The positive, preferably a platinum print or a bromide enlargement, is now adjusted with its projected main vertical on the exact prolongation of the plotting vertical and with its main horizon parallel to the projected image plane. In this position both views are secured and perpendiculars are dropped from similar objects represented in them to the image plane and lines drawn from operating points through intersections of these perpendiculars with the image plane; the points where these two lines meet is the true horizontal projection of the point sought. The elevation of the main horizon being known, the elevation of any point represented on any view can be easily deduced.

I confine myself in this sketch to above description of the graphic method of plotting, as a more detailed treatment would require some illustrating by cuts to render it intelligible; nor will I enter upon the description of the method of plotting from computed coordinates or by slide rule or plotting machines which have been constructed specially for this work by L. P. Paganini and Professor Meydenbaur. Suffice it to say that from my limited investigation of the practical application of photogrammetry, I feel convinced on the following points:

The photogrammetric method may be successfully employed to secure a correct projection of the natural shore line when shore can be approached to within about one mile, and to secure a correct projection of all topographical features which can be identified with the naked eye from the operating point. It will also yield such data as are required to project 20-foot contours, lacking, however, such detail as is hidden from view by timber.

This much information can undoubtedly be secured by this method at a very small cost—probably not more than one-fourth of the cost of the present topographical survey of St. Marys River. But to duplicate all the topography as secured in detail by this present survey would be possible only with the photogrammetric method by such a number of plates and correspondingly increased volume of plotting as would bring the expense greatly above that of the purely topographical survey.

But I am nevertheless thoroughly convinced that the photogrammetric method, as herein briefly outlined, has an eminently useful and proper place on any extensive topographical survey of a region where prominent hill or mountain ranges occur—either continuous or periodically—which, to closely survey with plane table or transit, is a slow and costly operation and yielding in the aggregate no better results than the photogrammeter would secure in greatly less time and a greatly less cost.

Respectfully submitted to First Lieut. Charles S. Riché, Corps of Engineers, United States Army, with my annual report dated June 30, 1895.

H. VON SCHON, *Assistant Engineer.*

F.—REPORT OF MR. JOSEPH RIPLEY, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., July 1, 1895.

SIR: I have the honor to report the progress of the hydrographic surveys and tertiary triangulation of the St. Marys River, Michigan.

Between Point Iroquois, at head of river, and Sweets Point, about 4 miles above Detour, soundings have been taken 50 feet apart on cross sections generally 500 feet apart; also estimate surveys have been made for a channel distance of 23 miles, the soundings being 10 by 50 feet apart for a width 400 to 800 feet; also, 10 by 10 feet apart for 400 feet wide and 4½ miles long on the rock sections of the improved channel; also, 10 by 50 feet apart on the Middle Ground off Round Island in Waiska Bay, covering an area of 8,000,000 square feet; in all, 390,000 soundings, which have been taken by my party during the part two seasons.

The tertiary triangulation has been completed between Point Iroquois and Rocky Point, on south shore of Mud Lake. That portion of it done the past season included the building and placing of cedar tripods on all the old stations for use of ice survey and topographical parties. Several stations had been destroyed, and eight of them were reestablished as near as possible to the old positions and the necessary angles read. During the month of November the triangulation at West Neebish was extended down to and across Mud Lake, thence connecting with the stations at Sailors Encampment. The system was planned, 18 new stations built, lines of sight cleared, most of them through windfalls and thickly timbered lands; angles were read at 25 stations, the distance between stations ranging from one-half to 6 miles. The stations were marked, as usual, with a piece of limestone about 1 foot square and placed 3 feet under ground, the station mark being the center of a one-half-inch drill hole in upper surface of stone. Five of the tripods were from 15 to 20 feet high. At least four series of angles were read at each station. The instrument used was the Pistor & Martin theodolite No. 1323, the micrometers of which read to two seconds of arc.

Most of the angles were read by Assistant Engineers Rohnert and Dixon, who alternately read and recorded a series of observations. Inspector Morrison and myself, with a party of eight men, reconnoitered and selected station sites, placed stations, and cleared lines of sight. Most of the triangles closed within four seconds, but there were some out ten seconds, it being impossible to get favorable weather conditions at some of the stations, as it was necessary to finish the triangulation before the close of the season so that the stations could be used for the ice survey. Ice formed 3 inches thick the last night that we were at the West Neebish, and it was with great difficulty that the tug and quarter boat were gotten out and around to Sailors Encampment. The regular estimate surveys for improvement of St. Marys Falls Canal, Hay Lake, and 21-foot channels were made at intervals during each month of the year. Characteristic soundings have been selected from those surveys for the new charts of the river. The special hydrographic surveys were made during the months of January, February, and March, 1895, except the open-water areas above and below St. Marys Falls, and at Little Rapids, which were sounded in the spring from boats by the method of time soundings between buoys.

The general plan of the survey was to sound every 50 feet on cross sections at right angles to the sailing lines and generally 500 feet apart for distances of 1,000 to 5,000 feet each side of the sailing line, and then extend alternate cross sections to the shoal water near shore. Where there was less than 30 feet of water in the channel the cross sections were taken 250 and sometimes 125 feet apart. The method of locating the soundings was as follows: All the tertiary triangulation stations and all other points used were referenced to a system of rectangular coordinates whose origin was at triangulation station 19, survey of 1879, and the axis of ordinates in the true meridian. The equations of the center or sailing lines of areas were computed and the coordinates determined of the points of intersection of the cross sections with the center lines and other parallel lines thereto, which were generally 3,000 feet apart. The azimuths from two shore stations to each point were computed. In the fieldwork the points are located by transit intersections and are marked with stakes placed in holes in the ice. The computations were made for the several areas down to Mud Lake last fall, except those in Lake George. For each area the coordinates of stations and points and the azimuths between stations and to the points were entered in duplicate notebooks for the use of the transit men. The computations for the areas, including Lake George, East Neebish, Mud Lake, and reach of river in the vicinity of Lime Island, were made in camp by the chiefs of parties, assisted by their recorders.

The details of the surveys are given in the interesting reports of Assistant Engineers Rohnert and Dixon and Inspector Morrison, each of whom was in charge of a party, and the large amount of work done over the main part of the river was due to their energy, good judgment, and management. The three parties were in camp

an average of seventy-eight days, of which twelve were Sundays, three idle days on account of stormy weather, and nine days moving camp, leaving fifty-four days for staking out and sounding. One hundred and seventy-five thousand five hundred and eighty soundings were taken, of which 39,813 were for the estimate surveys and the remaining 135,767 were taken 50 by 500 feet apart on an area of 176 square miles; the cross-section lines were from one-fourth to 10 miles long. The cost per sounding was 6 cents; the average cost per square mile was, for field work, $60.85; computations, $3.82, and mapping, $4.36, making a total of $69.03. The mapping included the platting of soundings and transferring same to record sheets, which were mapped on polyconic projections and showed contours for all the fathom and half-fathom curves. The least cost of field work per square mile was $29.29. The weather conditions were favorable, so that an area of 8 square miles was staked out, at a cost of $6.56 per square mile, and on one day 1,229 holes were bored, 50 by 500 feet apart, by one machine, and which were sounded by one leadsman, who pushed his sounding reel a distance of 13 miles. Fortunately, there were no accidents. Among the precautionary measures taken was the carrying of a coil of braided sash cord about 60 feet long on each boring machine and sounding reel, ready for use in case a man should break through the ice. The accuracy of the reel was tested by sounding several lines with poles and reel, and the soundings agreed to the nearest tenth of a foot. The development of the ice-boring machines and the sounding reels have greatly increased the efficiency of the ice-survey parties. At first, when axes, sounding poles, and lead lines were used, the men could not keep dry without wearing waterproof suits, rubber boots, and mits, which were cumbersome and were difficult to travel in, thus making the work extremely tiresome. Now the men keep dry and are not burdened with any more clothing than is necessary to keep them warm while walking. Each sounding has equal weight as to area and is accurately located, it being possible at any future time to duplicate the survey and take soundings within a foot or two of the places where they were in the original survey. The mapping of the soundings is reduced to the simplest form, and can be done for the least cost possible for making the figures. Very little time was lost on account of stormy weather, and then only when it was from 15° to 20° below zero and blowing a gale.

For the open waterwork one of the reels was removed from the sled and placed in the bow of a four-oared cutter and used for taking time soundings between bouys, and also along tagged lines, the depth of water varying from 15 to 60 feet. It was more accurate and rapid than using either sounding poles or ordinary lead lines, and much easier for the leadsmen.

The following suggestions are offered for future organization of ice parties: With a possible exception for long, narrow areas like those of Hay Lake and Little Mud Lake, where the lines of soundings are close together, the organization of a three-auger party is better balanced for economical work than is that of a two-auger party. We think it would be better to keep the three augers continuously at work, and in order to do so the party would have to be increased by one recorder and six laborers, who would do all the staking out and moving camp. In addition to the team of horses, two teams of well-trained dogs could be advantageously used to convey the transit men to and from stations, draw stakes, and carry meals out to the working parties on the ice. The labor of computing coordinates and azimuths would be minimized by taking lines of soundings parallel to the axes of coordinates.

The estimated cost of outfit for a three-auger party of thirty men is $1,300, in detail as follows:

Two transits, reading to ten seconds	$500
One level and rod	150
Three ice-boring machines, at $85	255
Five tents, complete	110
Three sounding reels	90
Four stoves, 1 cook and 3 heating	30
Cooking utensils	50
Table ware, tables, and benches	50
Axes, sight poles, canvas, etc	25
Marine glasses (3)	40
Total	1,300

Bedding to be furnished by the employees.

NARRATIVE.

The various methods used for making surveys on the St. Marys River have been devised from time to time to meet the peculiar conditions and requirements of the channel improvement, such as sounding in rapids and wide areas and the necessity of

accurately locating and taking soundings rapidly and repeatedly in the same places, in order to compute the bank measurements of excavated material for monthly and final estimates. The first changes from ordinary methods were made in the river survey of 1879 by Assistant Engineer Alfred Noble. The object of that survey was to determine the extent and location of shoals that needed improvement in order to obtain 16 feet of water for navigation through St. Marys River. A system of triangulation was extended along the river and enough additional stations built to locate the shore line and the soundings. No topography was taken except along the shore line. Interest attaches to the base-line measurements, as they were the longest among the first to be measured with a 500-foot steel tape. The work on the base lines was generally done on rainy or stormy days when river soundings could not be taken. Hubs 100 feet apart were driven on line between the two triangulation stations at ends of base line and sawed off to a uniform grade, unavoidable changes in grade being made at the 500-foot hubs. Holes bored in top of hubs were transited into line. The mode of procedure was as follows: Small pulleys about 2 inches in diameter were screwed in the holes in top of hubs. The steel tape (one-fourteenth of an inch wide) was placed on the pulleys. The mark near one end of the tape was held so as to coincide with a small center punch hole in nail on a hub, whose top was in the same grade plane as top part of groove of pulleys, by means of a line passing through the end loop of the tape and passed around a stake about 1 foot back of the hub. A 16-pound weight was attached to the other end of tape; the weight was raised so as to slack the tape and then gently lowered, and when there was a strain on the tape the 500-foot mark was referenced to a point on the nail. Several trials were made each time. The temperature of the tape was read from five attached thermometers. The tape was then carried forward for the next position by the men stationed at the hubs, who also took the pulleys along with them. The lines were measured from the opposite direction. The measurements were corrected for temperature, with the following results for the six base lines, expressed in feet:

Line.	Corrected to 62°.		Mean.	Correction for grade.	Length of line.
	First measurement.	Second measurement.			
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*
△ 3 to △ 5	2,219.375	2.219.025	2,219.200	—0.005	2,219.195
△ 11 to △ 13	3,122.409	3,122.425	3,122.417	—0.175	3,122.242
△ 19 to △ 21	7,127.503	7,127.595	7,127.549	—0.078	7,127.471
△ 36 to △ 38	9.116.650	9,116.807	9,116.728	—0.061	9,116.667
△ 55 to ⊡ 51	3,044.088	3,044.075	3,044.082	—0.007	3,044.075
△ 76 to △ 78	7,990.747	7,990.721	7,990.734	—1.091	7,990.643

A comparison of lines of the closing triangles is as follows:

△ 3 to △ 5 measured	2,219.195
△ 3 to △ 5 computed from △ 19 to △ 21	2,219.110
△ 3 to △ 41 computed from △ 19 to △ 21	3,951.860
△ 3 to △ 41 computed from △ 36 to △ 38	3,951.610
△ 55 to ⊡ 36 computed from △ 36 to △ 38	3,515.060
△ 55 to ⊡ 36 computed from △ 55 to ⊡ 51	3,515.720
△ 76 to △ 77 computed from △ 55 to ⊡ 51	10,647.980
△ 76 to △ 77 computed from △ 76 to △ 78	10,647.730

In addition to the triangulation and shore-line work the party of 59 men surveyed a total channel length of 38 miles. The channel navigated by vessels was included between two parallel lines of buoys from 500 to 1,500 feet apart; at the greater width a center line of buoys was usually set. It was sought to include all the area through which there was any probability of locating the channel to be improved. The area thus included was sounded by the time-sounding method. When time soundings showed a less depth than 22 feet, the area of shoal water was sounded from the raft. This raft was 16 feet by 100; it was attached by a line 2,500 feet long to a small scow anchored in the stream as near the channel as practicable. Suspended from the raft was a line of iron bars which could be lowered to any desired depth below the surface of the water. The "swinging line" connecting the raft and scow was attached to one end of the raft. At distances of 25 feet from each other along one side of the raft four rodmen were stationed, who took soundings at intervals of fifteen seconds as the raft was pushed across the channel by a small tug. At each sounding the direction of the raft was noted by compass readings; a staff at the center of the raft was located each fourth sounding by two transit readings by observers ashore. After crossing the channel the tug was changed to the opposite

side of the raft, 75 feet of swinging line paid out, and a new area across the channel sounded. In this way not only were a large number of soundings taken and located with considerable accuracy, but any scattered bowlders with less than 16 feet of water on them were located by the bars.

In the Middle and East Neebish rapids, it was impossible to use the method of time soundings. A line 500 feet long, on which were fastened corks every 25 feet, was stretched between two boats which were anchored by two kedges each, the upper boat lying directly in line with the current above the lower one. Soundings were taken with a sounding pole from a four-oared cutter, at each cork, the position of which was located by transit pointings to the sounding pole at instant of sounding, from two shore stations. After a line was sounded the boats were pulled over sideways about 25 feet and the operation repeated. The soundings thus taken were at irregular distances apart and would not answer for estimating the rock excavation in the proposed Neebish improvement. In 1883 the raft was enlarged to 20 feet wide and 130 feet long. Two lines of stakes 400 feet apart were driven parallel to the channel, the stakes being 260 feet apart in the direction of the channel. Where it was possible, tamarack or ash stakes were driven, but in the rock, sharpened tee rails were either driven or inserted in drilled holes. The stakes were driven with a small pile driver placed on a scow the position of which was located by the intersection of transit pointings from two of the shore stations. The scow was kept in position with three kedges and lines. From 15 to 25 stakes were driven in a day. The raft was then anchored with its upper end on line between the first pair of stakes, and one side in line with a row of stakes. It was swung into position by means of five kedges and lines, two on each side and one upstream; windlasses were used for handling the lines. Soundings were then taken every 10 feet along each side and through the middle of the raft. The raft was then moved sideways 30 feet at a time, this distance being known by means of tags on two or more light cross lines that were stretched above the water between two opposite stakes, and the taking of soundings repeated till the raft was moved from the line of stakes 200 feet to center of channel. It was then dropped downstream till its lower end was between the second pair of stakes, and the operation repeated. After one-half the channel width was sounded the raft was towed upstream and in a similar manner the survey was made of the other half of the channel. With six men on the raft an area of 200 by 1,200 feet could be sounded over in one day. On those sections of the river where the material to be removed was principally sand and silt, the cross sections were taken 50 feet apart, 400 feet long, and soundings every 10 feet on each cross section. Two parallel lines of wooden stakes, 400 feet apart, and the distances between consecutive stakes on each line, 500 feet, were driven. The soundings were located as follows: Two side lines of braided sash cord each 500 feet long and on which were fastened cedar corks every 50 feet were stretched between consecutive stakes on the side channel lines. Two small Mackinac boats, in each of which were two men, were anchored at corresponding corks on the side lines. A line of heaviest maitre cord about one-eighth inch in diameter, and tagged every 10 feet for 400 feet, was stretched between the side boats, and the soundings were taken from a third boat at each tag on the cross line. With favorable weather an area of 400 by 2,500 feet could be sounded over in one day. Water gauge readings were taken quarter hourly at gauges along the shore and opposite the soundings while all surveys were being made.

During the past winter the soundings were all referenced to mean tide, New York, allowance being made for the average fall of the water surface in the different reaches of the river. The planes of reference for the several areas are as follows, the elevations given being the number of feet above mean tide, New York:

Area.	Elevations.	Area.	Elevations.	Area.	Elevations.	Area.	Elevations.
	Feet.		*Feet.*		*Feet.*		*Feet.*
A	601.550	L	583.470	S	581.770	U	581.478
B	601.550	M	583.370	G	584.270	V	581.478
C	601.550	N	583.270	G	583.770	W	581.478
D	601.550	O	582.870	H	583.270	X	581.478
E	601.550	P	582.870	I	582.970	Y	581.478
F	601.550	Q	582.870	J	582.970	Z	581.478
K	582.770	R	582.570	J	582.770	&	581.478
K	581.728	S	582.270	T	581.728		

Equations of center lines of channels through sounding areas.

Areas.			
A — $y =$ —	1.205933 x —	6,481.68.	Referred to △ 11.
B — $y =$ —	4.699530 x +	313,375.38.	50 feet west of center of trestle. Referred to △ 19.
C — $y =$	0.287571 x +	7,431.90.	Referred to △ 11.
D — $y =$	1.460170 x +	38,097.63.	Referred to △ 19.
E — $y =$	0.559555 x +	9,137.70.	Referred to △ 19.
F — $y =$	0.312218 x +	4,201.75.	Referred to △ 19.
G — $y =$ —	0.345313 x +	1,639.19.	Referred to △ 19.
H — $y =$ —	1.964020 x +	14,045.11.	Referred to △ 19.
I — $y =$ —	1.239620 x +	3,221.318.	Referred to △ 19.
J — $y =$ —	1.753489 x +	9,291.56.	Referred to △ 19.
K — $y =$ —	0.398154 x —	44,527.54.	Referred to △ 19.
L — $y =$	1.497624 x —	29,522.02.	Referred to △ 19.
M — $y =$ —	0.800000 x +	42,492.00.	Referred to △ 19.
N — $y =$	0.383540 x —	5,980.17.	Referred to △ 19.
O — $y =$ —	1.496410 x +	90,124.27.	Referred to △ 19.
P — $y =$	2.232461 x —	124,290.30.	Referred to △ 19.
Q — North and south line, $x = 67,731.00$.			Referred to △ 19.
R — $y =$ —	4.459310 x +	180,103.70.	Referred to △ 19.
S — $y =$	37.486340 x —	2,045,212.48,	East Neebish. Referred to △ 19.
S — $y =$ —	2.571518 x +	82,404.15.	Referred to △ 19.
T — $y =$ —	15.904560 x +	810,740.70.	Referred to △ 19.
U — $y =$	3.844447 x —	318,601.78.	Referred to △ 19.
V — $y =$ —	0.882868 x +	774.29.	Referred to △ Winter Point.
W — North and south line, $x = 34,000.00$.			Referred to △ Winter Point.
X — $y =$ —	0.567447 x —	31,706.80.	Referred to △ Winter Point.

Coordinates of intersections of center lines with cross sections of the different areas.

Areas.					
A.	4,701.06	W.	812.51	S.	Section 2. Referred to △ 11.
B.	60,229.85	W.	30,323.39	S.	Section 0. Referred to △ 19.
C.	5,391.56	W.	5,881.44	N.	Section 0. Referred to △ 11.
D.	34,416.04	W.	2,155.62	S.	Section 0. Referred to △ 19.
E.	30,865.07	W.	8,133.00	S.	Section 8. Referred to △ 19.
F.	19,956.38	W.	2,028.99	S.	Section 0. Referred to △ 19.
G.	3,226.16	W.	2,753.23	N.	Section 0. Referred to △ 19.
H.	7,668.00	E.	1,015.00	S.	Section 0. Referred to △ 19.
I.	15,537.10	E.	16,038.77	S.	Section 0. Referred to △ 19.
J.	19,769.18	E.	25,373.46	S.	Section 0. Referred to △ 19.
K.	39,411.21	E.	60,219.28	S.	Section 0. Referred to △ 19.
L.	18,509.29	E.	1,802.08	S.	Section 0. Referred to △ 19.
M.	31,583.99	E.	17,224.78	N.	Section 0. Referred to △ 19.
N.	40,059.16	E.	9,384.16	N.	Section 0. Referred to △ 19.
O.	55,055.93	E.	7,737.72	N.	Section 14. Referred to △ 19.
P.	57,751.74	E.	4,638.24	N.	Section 0. Referred to △ 19.
Q.	67,731.00	E.	1,179.00	S.	Section 0. Referred to △ 19.
R.	45,487.80	E.	22,740.50	S.	Section 0. Referred to △ 19.
S.	48,925.05	E.	43,407.45	S.	Section 0. Referred to △ 19.
T.	55,155.80	E.	66,488.02	S.	Section 0. Referred to △ 19.
U.	58,919.27	E.	92,089.74	S.	Section 0. Referred to △ 19.
V.	7,948.25	E.	6,242.83	S.	Section 0. Referred to △ Winter Point.
W.	34,000.00	E.	30,000.00	S.	Section 0. Referred to △ Winter Point.
X.	34,000.00	E.	51,000.00	S.	Section 0. Referred to △ Winter Point.

The coordinates of the tertiary triangulation stations are given in the attached tables, and the reports of Assistant Engineers Rohnert and Dixon, and of Inspector Morrison, follow, marked 1, 2, and 3, respectively.

Very respectfully, your obedient servant,

JOSEPH RIPLEY,
Assistant Engineer.

First Lieut. CHARLES S. RICHÉ,
Corps of Engineers, U. S. A.

Coordinates of triangulation stations along St. Marys River, Michigan, referred to △ 19, survey of 1879.

No. of station.	East.	West.	North.	South.	No. of station.	East.	West.	North.	South.
1	8,863.35			*5,355.48	46 R	60,798.04			13,177.67
3	10,030.24			*10,402.29	46	60,756.06			13,187.24
4	13,245.15			*3,531.68	47	48,531.57		5,031.51	
5	12,285.03			*13,014.36	48	52,218.67			36,420.84
6	12,595.38			*8,187.26	49 R	46,553.15			10,670.42
7	14,428.98			*15,337.66	49	46,570.40			10,680.51
8	15,011.69			*11,276.53	50	55,103.62			44,365.46
9	16,030.30			*19,078.21	51	37,446.87			27,688.10
10	17,741.03			*14,601.79	52	59,040.92			49,657.49
11	17,881.83			*21,344.14	53	46,978.97			43,492.64
12	23,396.08			*19,846.09	54	54,831.76			54,039.43
13	19,891.39			*28,735.48	55	56,289.72			63,783.83
14	24,156.65			*23,204.34	56	62,084.55			59,948.56
15	20,347.81			*33,536.09	57	48,376.77			64,480.66
16	26,405.92			*31,373.86	58	58,779.74			68,748.96
17	21,697.19			*38,800.80	59 R	53,445.56			74,794.01
18	28,027.61			*37.717.37	59	53,460.92			74,847.10
19	25,872.19			*47,475.69	60	57,423.85			74,793.39
20	33,697.33			*42,908.56	61	54,854.72			82,223.90
21	29,044.47			*53,501.36	62	57,527.00			81,616.53
1		18,962.65		*2,862.13	63	57,318.06			85,448.39
2		13,634.10	4,273.38		63½	58,566.92			86,965.47
3		11,119.68		1,744.03	64	58,355.34			83,013.96
5		8,960.27		1,232.73	65	59,636.37			88,303.93
6		5,637.53	4,569.77		66	60,345.79			85,186.96
7		8,968.81	1,365.28		67	43,464.21			63,576.21
8	2,199.66		3,119.53		68	60,757.77			89,595.78
9		4,548.71		1,040.06	69	38,860.71			62,773.12
10 (v)	11,286.51			7,543.73	70	63,722.26			88,588.76
10		44,282.79		10,282.33	71	43,108.36			60,281.55
11		43,348.95		23,361.57	72	59,834.04			93,091.15
12		34,416.04		12,155.62	73	40,859.94			57,104.02
13		41,471.78		20,867.05	74	59,270.71			94,446.48
14	10,104.14			733.74	75	38,065.76			48,749.69
15		40,192.62		18,409.78	76	28,394.70			57,391.86
16	15,077.23			567.11	77	36,862.44			63,847.62
17		31,996.36		21,097.91	78	29,227.26			65,339.01
18	17,424.59			61.62	79	32,603.32			67,949.52
19	0.00	0.00	0.00	0.00	80	29,190.80			73,820.78
20	19,795.35		2,206.74		81	31,843.06			74,612.38
21	6,427.04			3,081.24	82	30,837.93			77,360.24
22	21,576.79		5,121.88		83	32,154.69			76,097.68
23	10,647.36			4,866.14	84	32,094.05			78,198.87
24	24,641.84		9,098.16		85	33,138.64			77,925.54
25	14,499.51			2,328.12	86	33,278.49			79,798.50
26	25.920.02		12,613.36		87	34,762.78			79,404.48
27	19,096.06			1,817.16	88	35,235.13			82,972.58
28	28,882.82		15,736.48		89 R	37,110.62			81,983.29
29	22,210.82		1,485.62		89	36,996.39			82,149.04
30	33,514.59		18,037.25		91	58,294.78			90,105.84
31	22,950.44		3,048.30		93	55 671.76			93,905.29
32	37,424.10		19,093.35		95	56,062.04			88,362.77
33	24,162.41		5,868.35		97	52.298.19			94,866.93
34	40,475.13		12,852.13		98	62,032.64			97,759.94
35	25.857.78		7,657.61		99	45,951.02			97,466.54
36	46,651.91		14,832.00		101	42,799.22			94,332.45
37	28,625.17		11,546.91		102	40,164.23			113,603.32
38	55,283.71		11,898.46		103	41,115.37			91,255.25
39	30,166.13		13,072.92		104	25,880.42			101,691.85
40	52,993.50		18,095.51		105	40,815.24			88,612.28
41	33,502.48		14,085.41		106	38,691.78			95,449.39
42	60,923.31		11,718.68		107	39,465.21			85,517.62
42½	72,973.54		2,158.20		108	39,612.47			93,593.25
43	37,943.56		8,154.23		110	39,124.35			90,755.50
44	65.230.92			179.07	112	38,240.69			88,503.20
45	46,197.09		9,753.61		114	37,237.50			85,891.59

* Hay Lake triangulation.

Coordinates of buoy stations along St. Marys River, Michigan, referred to △ 19, survey of 1879.

No. of station.	East.	West.	North.	South.	No. of station.	East.	West.	North.	South.
1	.....	21,830.08	.....	4,122.87	28	53,963.90	.....	.....	51,117.14
2	.....	15,966.58	2,905.69	.....	29	55,036.15	.....	7,087.33	.....
3	.....	16,187.86	.....	2,937.21	30	54,927.95	.....	.....	56,147,24
4	6,741.29	.....	2,284.43	.....	31	49,742.00	.....	3,361.96	.....
5	.....	14,602.09	.....	2,904.86	31½	38,457.24	.....	.....	21,118.23
6	31,051.05	.....	14,803.75	.....	32	56,540.98	.....	.....	59,864.06
7	.....	.....	.....	.....	33	40,655.16	.....	.....	23,604.09
8	45,074.09	.....	11,977.92	.....	34	59,194.82	.....	.....	65,669.23
9	.....	2,005.39	2,395.50	.....	35	39,039.24	.....	.....	33,036.84
10	47,666.71	.....	12,547.11	.....	36	56,762.39	.....	.....	67,266.97
11	.....	930.56	1,164.46	.....	37	48,514.92	.....	.....	40,393 03
12	49,908.72	.....	13,251.35	.....	39	48,925.13	.....	.....	43,407.28
13	3,862.43	.....	.....	1,286.80	41	50,986.57	.....	.....	50,566.50
14	52,050.33	.....	12,845.40	.....	43	52,479.11	.....	.....	53,120.88
16	54,236.55	.....	10.372.81	.....	45	52,999.35	.....	.....	55,648.41
17	18,043.83	.....	.....	918.08	47	54,690.94	.....	.....	58,284.97
18	54,248.01	.....	8,830.50	.....	49	54,278.57	.....	.....	64,442.73
19	36,487.30	.....	10,461.80	.....	51	53,336.24	.....	.....	64,518.59
20	55,471.65	.....	8,015.53	.....	53	51,673.57	.....	.....	63,315.59
21	40,059.16	.....	9,384.16	.....	55	45,482.06	.....	.....	61,782.61
22	56,686.64	.....	6,197.40	.....	57	48,376.77	.....	.....	64,480.66
23	43,872.54	.....	9,374.92	.....	59	53,046.00	.....	.....	67,867.71
24	52,703.32	.....	.....	38,885.75	60	43,874.63	.....	.....	63,167.50
25	47,324.49	.....	11,602.34	.....	A	54,202.61	.....	.....	53,712.79
26	51,634.00	.....	.....	46,841.35	B	54,487.83	.....	.....	54,980.35
27	52,593.42	.....	10,408.85	.....	C	48,538.70	.....	.....	61,915.58

Coordinates of triangulation stations along St. Marys River, Michigan, referred to △ 19, survey of 1879.

Name of station.	East.	West.	North.	South.
Winter Point	47,120.18	.....	.....	102,593.74
Rocky Point	54,730.91	.....	.....	116,023.55
A	.....	6,261.62	1,816.44	.....
B	.....	4,452.24	1,611.67	.....
A	.....	55.868.16	1,905.42	.....
B	.....	48,992.27	.....	5,340.58
C	.....	31,248.14	.....	7,529.95
D	.....	33,146.74	.....	183.60
E	.....	26,020.05	1,049.46	.....
I	.....	63,667.15	.....	19,414.55
K	.....	66,319.35	.....	26,901.71
L	.....	54,167.02	.....	28,882.29
M	.....	46,894.86	.....	23,213.99
N	.....	29,717.03	.....	9,807.81
O	.....	26,299.01	.....	7,545.85
P	.....	21,498.00	.....	4,226.55
R	.....	19,019.71	.....	2,871.34
L. H	.....	44,882.89	.....	19,801.19
Iroquois	.....	80,761.52	.....	9,084.06
South Gros Cap	.....	63,250.50	13,221.88	.....

Coordinates of triangulation stations along St. Marys River, Michigan, referred to △ Winter Point.

No. of station.	East.	West.	North.	South.	No. of station.	East.	West.	North.	South.
200	16,307.0			3,452.7	222	69,214.2			30,442.4
201	16,670.0			21,328.0	223	62,861.0			64,413.1
202	20,265.0			9,021.5	225	66,068.2			69,197.0
202 *a*	24,549.0			13,293.0	227	61,566.9			74,335.8
203	23,138.0			25,383.0	228	79,796.3			28,888.8
204	35,189.6			19,821.9	229	77,981.9			69,066.9
205	24,791.0			37,235.4	230	85,650.4			31,411.0
206	38,258.6			33,003.0	231	72,527.9			75,252.2
207	35,709.8			45,726.3	232	89,913.4			32,669.3
208	44,702.6			39,051.4	235	69,513.0			82,955.8
209	39,755.3			44,199.4	245	65,175.5			56,698.5
210	48,788.7			44,760.4	247	69,078.3			52,511.4
211	44,526.2			51,320.4	253	76,532.0			49,579.0
212	50,198.3			51,929.4	261	75,600.1			56,921.4
213	44,903.0			54,752.6	263	77,383.5			59,329.8
214	56,383.6			54,530.9	267	82,271.6			64,256.7
215	38,076.4			62,379.5	273	85,071.7			77,538.0
216	64,161.3			52,363.7	277	94,447.5			73,762.0
217	43,270.6			67,560.5	283	91,555.4			64,535.6
218	66,059.8			47,953.0	285	91,218.1			55,328.1
219	49,302.6			67,857.5	287	86,212.5			51,412.4
221	55,317.6			67,070.5	291	82,594.0			41,266.1

Points Referred to △ Winter Point.

Name of station.	East.	West.	North.	South.
Winter Point iron tower	76.9		706.4	
Pilot Island, outside range	4,614.6			14,500.0
Round Island Light	33,430.5			38,941.4
Sweets Point Light	54,868.6			65,403.5
Detour Light-House	60,042.6			94,730.0
Pipe Island Light	64,063.2			72,691.2
Detour church spire	62,958.5			78,876.7
Detour smokestack	64,106.3			80,832.8
Frying Pan Light-House	65,016.1			83,442.6

Coordinates of triangulation stations along St. Marys River, Michigan, referred to △ Winter Point.

Name of station.	East.	West.	North.	South.
Winter Point	00.0	00.0	00.0	00.0
Rocky Point	7,570.6			13,451.0
Salters Hill	42,018.0			7,645.4
Pointe aux Frênes	31,162.6			30,617.0
Fort St. Joe	52,054.6			55,599.0
Detour	60,290.9			79,772.0
Raber	30,553.6			54,641.5
Burnt Point	69,509.0			43,653.0
Drummond	72,753.6			78,121.0
Bacon Island	82,581.6			57,419.8
Harbor Island	98,106.0			59,294.3

1.—REPORT OF MR. BENNO ROHNERT, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., June 20, 1895.

SIR: I have the honor to make the following report on the ice survey work of hydrographic party No. 2, during the months of January, February, and March, 1895:

According to written instructions received from C. S. Riché, first lieutenant, Corps of Engineers, U. S. A., dated December 19, 1894, and relative to a hydrographic resurvey of St. Marys River, that section of the river lying between Little Rapids and the upper end of St. Joseph Island and passing through Lake George, was assigned to hydrographic party No. 2, one of the three parties detailed to make the

resurvey. This section included areas L, M, N, O, P, Q, R, and S of the adopted ice survey project. On completion of the above mentioned areas, such additional areas or parts of areas were to be assigned to the party as they could survey before the breaking up of ice. Such areas or parts of areas were G, U, V, W, and X.

The areas are located as follows:

G.—From Topsail Islands to Little Rapids.
L.—From Little Rapids to Little Lake George.
M.—Little Lake George.
N.—From a point one-half mile above Manhattan Crib Light to Little Lake George.
O.—From a point one-half mile above Manhattan Crib Light to Lake George.
P.—From head of Lake George to head of Lake George Flats.
Q.—Echo Bay.
R.—From head of Lake George Flats to Advance Island.
S.—From Advance Island to head of St. Joseph Island.
U.—From Sailors Encampment to Two Tree Island, Mud Lake, including Munuskong Bay.
V.—From Two Tree Island to Pointe aux Frênes.
W.—From Pointe aux Frênes to foot of Lime Island.
X.—From foot of Lime Island to Sweets Island Light.

P and R embrace the whole of Lake George and U and V the whole of Mud Lake.

It would have been preferable to have had the party begin its work at the upper end of its section of the river. This would have done away with several long hauls in moving camp and consequently reduced its expenses. But owing to the very swift currents in the narrow portions of the river between Little Rapids and Lake George, a large part of this area was not entirely frozen over and therefore the idea of beginning at any point above the head of Lake George was abandoned.

Preliminary preparations, such as gathering together the camp outfit and packing same for shipment, having been completed, hydrographic party No. 2, with its effects on two sleighs, departed from Sault Ste. Marie on January 10, 1895, for its first camping ground. A suitable spot was found west of triangulation station 49 R which is situated on Hay Point, Lake George. This point was chosen because from it all parts of area "P" were easily accessible and could be speedily reached. Both sleighs were here unloaded. The party's team and sleigh were retained and the extra one ordered to Sault Ste. Marie. The entire party immediately turned their attention to pitching camp, and at 8.30 p. m. the men were comfortably quartered.

Complete organization found the personnel of the party to be as follows:

Assistant engineer: Benno Rohnert, chief of party.
Recorders: J. I. Conklin, C. E. Thompson, and C. W. Given.
Leadsmen: Joseph Bayliss, Jacob Bainbridge, and Ross Eckardt.
Head machinemen: Robert Cumming, Eugene Menard, and John Sheeran.
Flagmen: Arthur Beebe, W. J. Steere, and George Freeborn.
Machinemen: G. Pembroke Tucker, Archy McQueen, William Atkinson, James Keller, Michael Donnelly, and John Gauthier.
Cook: Penry A. Rees.
Camp attendant: Frank Stevens.
Water gauge reader: B. P. Fuller.
Teamster: Charles A. Troyer.

No important changes in personnel were made until March, when, Recorder Conklin's entire time being taken up with computations, Joseph Bayliss became recorder of crew No. 1, Robert Cumming its leadsman, and Frank Stevens its machine man. The party numbered 23 men. The chief of party's duties were the general supervision and direction of the work. Each recorder, who had entire charge of his crew while prosecuting its field work, recorded all soundings taken by the leadsman. The recorder of crew No. 1 was in reality head recorder and had such extra duties to perform as assisting the chief of party in staking out the work, computing azimuths from stations to stakes, and transferring levels from bench mark to bench mark. Besides taking soundings the leadsman kept his sounding reel in working trim. Under the recorder's supervision the head machine man practically had charge of the ice-boring machine, keeping the auger and the several parts of the mechanism in good running order. The flagman placed markers at the stakes set on the cross sections along which his crew were about to sound and thereby tested their alignment. The cook and camp attendant usually worked conjointly. Besides attending to preparation and serving of meals they supplied the camp with wood and water and did such other chores about the camp as were from time to time required of them. The water-gauge tender read water gauge every fifteen minutes during the time that the crews were at work in the field. He had one camp duty to perform, that of keeping the lanterns in good condition. He also assisted in establishing new gauges. The teamster was continually occupied with the care and driving of the

team. They were employed in conveying the crews to and from camp and field, in hauling provisions, etc., from Sault Ste. Marie to camp, in moving camp outfit from place to place, and in hauling wood to camp. The men were specially selected for crew No. 1, as they were expected to do the staking out and were better fitted for it on account of their previous experience in this class of work.

A 12 by 12 foot tent was used as an office tent. In it were stored all of the surveying instruments and stationery. It also furnished sleeping accommodations for the chief of party, the recorders and leadsmen, and storage room for their luggage. This tent was afterwards changed to 14 by 14 feet, and housed 8 men. The cook tent, which was 12 by 16 feet, contained all articles used in the culinary department, such as stoves, pots, kettles, dishes, chests of provisions, etc. In it were erected two dining tables and four rows of benches, with a seating capacity of 21. Tinware was used in setting tables because it occupied a smaller space in packing and breakage was less than with china ware. The cook and camp attendant slept in an 8 by 10 foot tent pitched in the rear of the cook tent and connected therewith. The men's sleeping tent was 14 by 14 feet and accommodated 14 persons fairly comfortably. The team, which was constantly with and used by the party, occupied a 10 by 12 foot tent. This was afterwards changed to a 12 by 12 foot tent. All tents were furnished with flies.

It was quite evident from the outset that hydrographic party No. 2 would have to break and pitch camp quite frequently. In pitching the first camp no attempt was made to particularly organize the party for this purpose, as it was extremely desirable to find out each man's capabilities in this line and then to divide them into several squads, so that each of them could perform the duties assigned to it without interfering with the others. The members of the party were apportioned as follows: 6 shovelers, 5 tent men, 3 axmen, 2 gauge tenders, and 2 guards. From one to two hours before breaking camp, and having received the requisite information relative to the approximate location of the next camping ground, Recorder Thompson proceeded to that locality for the purpose of making a careful examination of the surrounding territory. His instructions were to select high, dry ground, sufficiently wooded to act as a protection against the winds, particularly those from the northern quarter. He was also to establish a gauge stake and take gauge readings until relieved. In the meantime each man had been busily engaged in packing up his blankets and personal effects and stacking same in the center of tent. After breakfast the axmen and guards began loading the cook's entire outfit into the sleigh. The shovelers cleared the snow away from the lower edges of the tents and pulled up the tent pins. The tent men lowered and folded the tents and loaded them into the sleigh. The bedding, surveying instruments, sight poles, and such other property as was left behind were placed in charge of the guards. The water-gauge observer proceeded to read gauge, so that its elevation could be transferred to new camp by simultaneous readings. While the first load was traveling along the way to the new camping ground the axmen with axes in hand preceded it by about 1,000 feet and tested the thickness of the ice, thereby assuring the teamster as to the safety of his road. In case an accident might have befallen the sleigh the shovelers and tent men, ready at any moment to unload it, walked alongside. On reaching the new camp ground the axmen cut a road through the timber to it and cleared it of all brush and trees. The shovelers cleared the snow away from the areas selected for the different tents. As fast as the areas were prepared the tent men, who had unloaded the sleigh and sent it back for the second load, pitched the cook, office, men's, and stable tents in the order named. They were supplied with stakes, pins, and poles by the axmen. One tent man gave his especial attention to the placing of stoves. As soon as his tent had been pitched the cook, with such assistance as he could obtain, placed his outfit within and again began his customary work. The office and men's tents were placed alongside of each other with the cook tent to the eastward. All tents were faced a southeasterly direction, so that the uncut back wall would present a solid front to northwesterly winds, which were the coldest and heaviest. The stable tent was placed about 200 feet from the cook tent. A latrine was built about 300 feet away from the nearest tent. After banking the erected tents with snow the shovelers, together with the axmen, gathered balsam tops from 8 to 12 inches long. These were carried to the tent men, who placed them on the ground with butt end downward and in such manner that when the bedding was unrolled upon them a resting place was furnished that was perfectly dry and very springy. On the arrival of the last load of property from the old camp each man took therefrom his luggage and placed it in the proper space alloted to him in the tent. All the tools and property that the inclemencies of the weather would not materially injure were stacked just outside of the men's tent. The speed of the team, breaking a new road through 10 inches of snow and drawing a load of 2 tons, varied from 2 to 2½ miles per hour. There was never less than one day spent in moving camp. Not including the two long hauls of 18 and 40 miles the average distance was about 5 miles. Hydrographic party No. 2 occupied eight different camps during the survey season. The shortest time that any one camp was occupied was four days. The longest time was fourteen days.

Certain rules relative to camping ground and vicinity were established. Their enforcement resulted in the best of sanitary conditions.

In the hydrographic survey the base line of each area (usually called "center line") was the established sailing course through that area. The cross sections, which were 500 feet apart, were perpendicular to the center line. In the narrow portions of the river each cross section was sounded from shore to shore. In the wide portions each one was sounded to a distance of 1,000 feet on each side of the center line and every second one to shore. In addition, intermediate sections midway between the cross sections were sounded between the 20 and 30 foot contour lines. In case a shoal was found a more exact survey was made, so as to determine its size and shape. This system was used for all areas save "L." In this area the depth of water varied so greatly and so suddenly that it was deemed advisable to sound every 250-foot section from shore to shore, with 125-foot intermediate sections. Soundings were taken every 50 feet along the cross sections.

The triangulation stations which had been previously established along the shores of the river were used for staking out. Their rectilinear coordinates, using as axes of reference the north and south and east and west lines passing through one of the stations as origin, were computed. The equations of center lines of channel were likewise computed. From this information the distances between stations, the azimuths from station to station, and the azimuths to any point of the center line from any station were easily calculated. Since it was necessary to locate stakes on the ice for the guidance of the different crews, each area was cut up by longitudinal sections parallel to the center line. The ones that were located 1,000 feet each side of the center line were called side lines of the channel. Additional ones were established 3,000 feet apart and parallel to the side lines. Their number was limited by the distance from the side lines to the adjacent shore. The stakes were to be placed at the points of intersection of the cross sections with the longitudinal sections. For staking out purposes each area was divided into several parts, the stakes of each part being set from two triangulation stations. Azimuths from these two stations to each stake were computed. If possible such stations were selected as would give a short sight to and clear view of the stakes as well as a good intersection of transit pointings. In staking out transits were set over each station and oriented by taking pointings to two or more triangulation stations which had been previously flagged. The azimuths of the stake to be set were turned off. The flagman proceeded along the line given him by one of the transit men until he arrived at the line given by the other, where the point of intersection was marked. A hole was there chiseled through the ice sufficiently deep to draw water and a stake, inscribed so as to designate the line and cross section, placed therein. This operation was repeated for each stake along the several longitudinal sections until all that could be set from the two occupied triangulation stations had been placed. The flagman in obtaining lines used a 12-foot sight pole whose length was divided into foot sections painted red and white alternately. To the lower end there was attached a chisel point and to the upper end a red, white, and blue flag, whose bars were perpendicular to the sight pole. The transit man used a signal flag with red and white stripes. The signals employed were few. When the transit man held the signal flag to the north, south, east, or west the flagman moved his sight pole accordingly. When the signal flag was held vertically it indicated that the sight pole was on line. Waving the flag several times from the one side to the other signified "stake driven." The last-mentioned signal was first given by the flagman, and only when he had located the stake point and both transit men were holding their flags vertically. Before proceeding to the next point the flagman had to receive the same signal in answer from both stations. In case the transit men's signals could not be seen by the flagman repeaters with signal flags in hand were stationed at intermediate points.

When sounding the staking crew took that portion of an area included by the side lines of the channel; the other crews took the portions between the side lines and the shore. This division seemed to keep the crews working close together, which was well worth considering on account of its saving considerable extra teaming. Sufficient stakes having been set for a crew, its six men began their work. As soon as the flagman had placed markers at the several stakes of a cross section for his crew the boring machine was placed in position at the starting stake and the first hole bored. The boring machine was similar to the one generally used by the Government in making ice surveys. A steamboat-bell cord was attached to the boring machine so that its free end was a distance of 50 feet from the axis of the auger. While the machine man and the turner of crank were boring, the third man, who had lined himself in by the stake ranges, marked the spot at the end of the cord for the next hole by scratching the ice with a nail. The auger was again placed in position and boring begun. The boring machine was closely followed by the sounding reel, commonly known as the "Ripley" reel. The reel is simply constructed, being merely a wheel of 10 feet circumference mounted on a light set of runners. The rim is graduated into feet and tenths of a foot. The number of revolutions are shown by an indicator. A pointer attachment enables the leadsman to

correct the sounding by the distance that the water surface is above or below the plane of reference. About twenty turns of wire, to the end of which is attached a sounding lead, encircled the wheel. The sounding reel was so placed that the lead hung directly over the hole through which the sounding was about to be taken. The wire was then unwound until the lead reached the bottom and the sounding read and called to the recorder, who checked the reading and recorded same in the proper place in his note book. The cross section being finished the crew immediately proceeded to the next section, whose stakes in the meantime had been suitably marked by flags.

The water-surface correction was furnished to each recorder at least twice a day, in the morning and at noon. It was also transmitted to them whenever a variation of a tenth of a foot from the already reported correction had taken place. The method of transferring the elevation of some established bench mark to the reference bench mark was by simultaneous water-surface readings. Near camp a permanent object, such as the root of a tree or top of a boulder, was selected to receive the reference bench. Opposite to this point and to that of the established bench mark stakes were driven into the river's bottom where the water was shallow. The difference of elevation between the nails driven into the tops of these stakes and the adjacent benches were obtained by level and rod. The difference of elevation of the nails was found by taking comparative readings from nail to water surface every fifteen minutes during the day. Reduction of the observations gave the desired elevation of the reference bench mark. Seven such benches were established during the winter. In order that the water-gauge tender might observe the correction without any reductions a gauge stake was driven whose nail was set at the exact elevation of the reference plane. This elevation was checked every morning.

The party were in the field for eighty days, of which twelve were Sundays, and four were lost on account of the inclemency of the weather. This leaves a total of sixty-four working days. The amount of work done is as follows:

Area.	Square miles.	Number of soundings.	Area.	Square miles.	Number of soundings.
P	17.1	11,270	G	1.4	2,129
Q	1.8	516	U	16.0	9,230
R	13.4	10,182	V	13.9	10,321
S	3.0	2,990	W	2.9	1,170
M	2.7	2,169	X	5.3	3,549
N	0.3	430			
O	0.3	273	Total	80.2	59,075
L	2.1	4,846			

It is plainly seen that for each day that the party was in the field 1 square mile was surveyed, and for each working day about 1.6 square miles. Shoal Point Lighthouse, situated at the head of St. Joseph Island, in the Canadian channel, was located by being read in from triangulation station 55 and buoy station 32. The angle at triangulation station 208, between triangulation station Point aux Frênes and Raber Smokestack, was also read. A shoal was found northeast of Point aux Frênes and a sufficiently accurate survey thereof made in order to estimate the amount of material above the 21-foot grade line to be removed in case improvement is thought advisable.

The meals were served and paid for by the Government. Good, wholesome food and plenty of fresh meats were supplied. The number of meals furnished was 5,004 at a total cost for provisions of $758.76, or about 15$\frac{1}{6}$ cents per meal. Including the cook's wages the total cost amounted to $929.93, or about 18$\frac{3}{5}$ cents. The cost per ration, without cook's wages, was 45$\frac{1}{2}$ cents, and with his wages, 55$\frac{3}{4}$ cents. The cost of boarding party per square mile of work, without cook's wages, is about 9.09\frac{7}{10}$, and with his wages about 11.59\frac{1}{2}$.

Since this party was sent into the field with very few of the stake azimuths computed, and since the head recorder's time was partly occupied in computing same for other parties, it is necessary for a fair comparison to deduct the expense incurred by this work. The total expenses of the party were as follows:

Groceries and provisions		$758.76
Total amount of pay rolls		4,010.55
Oil, soap, nails, cotton, flannel, etc		20.00
		4,889.31
Stake computations for other parties	$51.30	
Stake computations made in field	285.90	
		337.20
		4,552.11

Including all expenses save those of computing azimuths to stakes, the cost per square mile is $56.78. The computations for the stakes of 74 square miles were made at a cost of $285.90, or $3.86 per square mile. So that, including the cost of computations for the entire mileage covered by the party, we have the grand total of $4,861.68 or $60.62 per square mile. This last amount includes every expense incurred by hydrographic party No. 2, in sounding its section of the river, save the wear and tear of the outfit, whose value was between $900 and $1,000. The most of the outfit was on the Government property returns, had seen years of service, and probably will see many more; consequently a percentage of its value was not included in the expenses incurred.

The total number of soundings taken is 59,075.

The cost per sounding was as follows: $6\frac{4}{11}$ cents each without meals and without cost of stake computations; 7 cents each without meals and with cost of stake computations; $7\frac{7}{10}$ cents each with meals and without cost of stake computations; $8\frac{1}{4}$ cents each with meals and with cost of stake computations.

The largest cost per square mile to stake out an area was $19.11, in P, and the least, $6.56, in U. In area P, the work was delayed by snowstorms and, on clear days, by clouds of fine, dry snow being blown along the ice. In area U, the clear view and fine condition of atmosphere permitted of the staking out being carried on with all possible speed. The area that cost the most to sound was L, at $145.79 per square mile, and the least, area R, at $23.65 per square mile. In area R the average thickness of the ice was only 18 inches. The snow covering the ice was just deep enough to facilitate rather than retard the progress of the sounding. In area L several conditions offered themselves to retard the work. The snow, which was soft and heavy, had a depth of 16 to 36 inches; small areas of open water were frequently encountered; the ice had an average thickness of 24 inches and was covered by 3 to 6 inches of water; and the cross sections were more numerous than in any other area. Dragging the machines through deep snow is exceedingly hard work and very tiresome.

Hydrographic party No. 2 broke the last camp and returned to Sault Ste. Marie on the 28th day March. In conclusion it might be said that notwithstanding the extremely cold winter of this northern country the members of the party were better satisfied with their work than had at first been anticipated. They were well provided for in the line of food and shelter. The men were industrious, willing, painstaking, and anxious to see the work progress. Only words of praise can be uttered for Recorders Conklin, Thompson, and Given, who so faithfully performed their duties. In fact, the winter's successes and the congeniality of the crew's members should be largely attributed to them. If requested of them, they would very willingly assist the chief of party in computations, reductions, copying notes, etc., until midnight, after having spent the entire day in the field.

Very respectfully, your obedient servant,

BENNO ROHNERT, *Assistant Engineer.*

MR. JOSEPH RIPLEY,
Assistant Engineer.

2.—REPORT OF MR. CHARLES Y. DIXON, ASSISTANT ENGINEER.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., July 1, 1895.

SIR: I have the honor to submit the following report of the work done by hydrographic ice survey party No. 3 during the months of January, February, and March, 1895, while taking soundings to be used in completing charts of St. Marys River for navigation purposes:

In accordance with your verbal instructions, the entire party left Sault Ste. Marie, Mich., on the morning of Monday, January 14, with two loads of camping outfit, for Waiska Bay, preparatory to beginning work on areas A and B of the adopted ice-survey project, and camp was made on the American shore in the vicinity of Bound Island. The two teams were sent back to the Sault, one to remain there and the other to take ice-boring machines and other tools to camp and to remain with the party during the season of active operations. This team was furnished by J. W. Burgess, of Sault Ste. Marie.

This hydrographic party was known as a "three-auger party," and consisted of the chief of party, 3 recorders, 3 leadsmen, 14 laborers, the cook, and the teamster, making in all 23 men. There were 3 sounding crews of 6 men each, consisting of 1 recorder, who recorded the soundings and directed the operations of the party while at work, and was held responsible for the work done by his party; 1 leadsman to take the soundings, and four laborers. One of these laborers was designated as machine laborer, it being his duty to keep the ice-boring machine in good working order, to make a record in a book for that purpose of the time of beginning and ending of each line

LAWS

AFFECTING

THE CORPS OF ENGINEERS,

UNITED STATES ARMY,

FIFTY-THIRD CONGRESS, THIRD SESSION.

1894-95.

ENG 95——267 4257

LAWS

AFFECTING

THE CORPS OF ENGINEERS, UNITED STATES ARMY.

FIFTY-THIRD CONGRESS, THIRD SESSION, 1894–95.

PUBLIC ACTS.

CHAP. 8.—An Act To amend the Act entitled "An Act to authorize the construction of a bridge across the Mississippi River above New Orleans," approved January twenty-six, eighteen hundred and ninety-three. December 24, 1894.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act entitled "An Act to authorize the construction of a bridge across the Mississippi River above New Orleans," approved January twenty-six, eighteen hundred and ninety-three, be, and the same is hereby, amended so as to extend the time for the commencement of the construction of said bridge to three years and its completion to six years from the approval of this Act.

Time for bridging Mississippi River at New Orleans extended. Vol. 27, p. 426.

Approved, December 24, 1894.

CHAP. 11.—An Act To amend section eight of the Act entitled "An Act to authorize the construction of a bridge across the Contentnea Creek, at Grifton, Lenoir County, North Carolina, and to establish it as a post road," approved August twenty-third, eighteen hundred and ninety-four. December 26, 1894.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section eight of the Act entitled "An Act to authorize the construction of a bridge across the Contentnea Creek at Grifton, Lenoir County, North Carolina, and to establish it as a post road," approved August twenty-third, eighteen hundred and ninety-four, be, and the same is hereby, amended so as to extend the time for the completion of said bridge to six months from the approval of this Act.

Time for bridging Contentnea Creek, N. C., at Grifton extended. Laws, 2d sess. 53d Cong., p. 490.

Approved, December 26, 1894.

January 7, 1895.

CHAP. 19.—An Act Supplementary to an Act entitled "An Act establishing a court of appeals for the District of Columbia, and for other purposes," approved February ninth, eighteen hundred and ninety-three.

District of Columbia.
Potomac flats suit to be tried in supreme court, D. C.
Vol. 27, p. 434.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That nothing contained in the Act approved February ninth, eighteen hundred and ninety-three, entitled "An Act to establish a court of appeals for the District of Columbia, and for other purposes," shall be construed to affect in any manner the power and jurisdiction conferred upon the supreme court of the District of Columbia by the Act approved August fifth, eighteen hundred and eighty-six, entitled "An Act to provide for protecting the interests of the United States in the Potomac River flats in the District of Columbia;" and that the suit instituted by the Attorney-General in said last-mentioned court, in accordance with the terms of said last-mentioned Act, shall proceed to a final hearing in said supreme court and in the Supreme Court of the United States in the same manner as if said Act establishing a court of appeals for said District had not been passed.

Vol. 24, p. 335.

Approved, January 7, 1895.

January 8, 1895.

CHAP. 21.—An Act To amend an Act entitled "An Act to authorize the construction of a bridge across the Missouri River at some point within one mile below and one mile above the present limits of the city of Jefferson, Missouri," approved May twenty-eighth, eighteen hundred and ninety-four.

Bridge across Missouri River, Jefferson City, Mo.
Provisos.
Pivot draw.
Laws, 2d sess. 53d Cong., p. 81.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That section three of the Act aforesaid be amended by adding the following after the word "prescribed" in the last line of said section, to wit: *Provided*, That said bridge may be a pivot drawbridge; and if the same shall be constructed as a pivot drawbridge it shall have one draw span affording two clear openings of not less than two hundred feet each, which draw span shall be maintained over the main channel of the river at an accessible and navigable point and with a fixed span or spans each not less than three hundred feet in length in the clear; and the head-room under each span shall not be less than ten feet above the standard high-water grade line, and the piers of said bridge shall be parallel with and the bridge itself at right angles to the current of the river: *Provided, also*, That said draw shall be opened promptly by said company, upon reasonable signal, for the passage of boats and rafts: *Provided, further*, That the said Jefferson City Bridge and Transit Company shall, at its own expense, build and maintain, under the direction and supervision of the Secretary of War, such wings, dams, and booms, or other work necessary to maintain the channel within the draw span of said bridge, and shall, at their own expense, maintain a depth of water through said draw span not less than that now existing, as shown by the report of

Opening draw.
Aids to navigation.

the War Department, at the point where said bridge may be located; and if said Jefferson City Bridge and Transit Company shall fail to maintain such channel aforesaid, then the Secretary of War may cause said channel to be opened and maintained at proper depth for navigation through said span, at the expense of the owners of said bridge.

Approved, January 8, 1895.

CHAP. 33.—An Act To amend the Act entitled "An act authorizing the Texarkana and Fort Smith Railway Company to bridge Little River in the State of Arkansas," approved April twenty-first, eighteen hundred and ninety-four. January 19, 1895.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act entitled "An Act authorizing the Texarkana and Fort Smith Railway Company to bridge Little River in the State of Arkansas," approved April twenty-first, eighteen hundred and ninety-four, be, and the same is hereby, amended as follows: Bridge across Little River, Ark. Laws, 2d sess., 53d Cong., p. 62.

"That if the said bridge shall be made with unbroken and continuous spans, there shall be at least one span of a height of not less than forty feet above low water, as understood at the point of location, measured to the lowest part of the superstructure of said bridge; and said span shall have an opening of two hundred and fifty feet from center of pier to center of pier." Height reduced.

SEC. 2. That the time for the commencement of the construction of said bridge is hereby extended to within one year and its completion to within three years from the approval of this Act. Time for constructing extended. Laws, 2d sess., 53d Cong., p. 64.

Approved, January 19, 1895.

CHAP. 43.—An Act Making appropriations to supply urgent deficiencies in the appropriations for the fiscal year ending June thirtieth, eighteen hundred and ninety-five, and for other purposes. January 25, 1895.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, to supply deficiencies in the appropriations for the fiscal year eighteen hundred and ninety-five, and for other objects hereinafter stated, namely: Urgent deficiencies appropriations.

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WAR DEPARTMENT. War Department.

For improving harbor at Galveston, Texas: For continuing improvement, under existing contracts, two hundred thousand dollars. Galveston Harbor, Tex.

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Approved, January 25, 1895.

January 25, 1895.

CHAP. 46.—An Act Authorizing the Little Rock and Pacific Railway Company, its successors and assigns, to construct and maintain bridges across the Fourche La Fevre and Petit Jean rivers, in Arkansas.

Little Rock and Pacific Railway Company may bridge Fourche Le Fevre and Petit Jean rivers, Ark.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Little Rock and Pacific Railway Company, a corporation created under the laws of Arkansas, authorized to construct a line of railway from the city of Little Rock westward through the State of Arkansas to the line of the Indian Territory, its successors and assigns, be, and is hereby, authorized to construct and maintain bridges across the Fourche Le Fevre and Petit Jean rivers, in Arkansas, at such points as may hereafter be selected by said railway company for crossing said rivers on its line of railway; that said bridges shall be constructed for the passage of railway trains, and at the option of said railway company may be used for the passage of wagons and vehicles of all kinds, and for the transit of passengers, charging and receiving such toll as may be fixed by said railway company and approved by the Secretary of War.

Railway, wagon, and foot bridges.

Toll.

Lawful structures and post routes.

SEC. 2. That said bridges shall be lawful structures, subject to the limitations of this Act, and shall be recognized and known as post routes, upon which no higher charge shall be made for the transmission over the same of the mails, the troops, and munitions of war of the United States than the rate per mile paid for the transportation over the railway or public highways leading to said bridges, and they shall enjoy the rights and privileges of other post roads in the United States; and the equal privileges in the use of said bridges shall be granted to all telegraph companies, and the United States shall have the right of way across said bridges and their approaches for postal telegraph purposes: *Provided*, That all railroad companies desiring the use of said bridges shall have and be entitled to equal rights and privileges relative to the passage of trains over said bridges and over the approaches thereto, upon payment of reasonable compensation for such use; and in case of any disagreement regarding the compensation to be paid or the conditions to be observed, all matters at issue shall be decided by the Secretary of War upon proper hearing.

Postal telegraph.

Proviso.
Use by other companies.

Secretary of War to approve plans, etc.

SEC. 3. That the bridges authorized to be constructed under this Act shall be built and located under and subject to such regulations for the security of navigation of said rivers as the Secretary of War shall prescribe, and to secure that object the said railway company shall submit to the Secretary of War for his examination and approval a design and drawing of each of said bridges, with map of the location thereof, and shall furnish such other information as may be required for the full and satisfactory understanding of the subject; that neither of said bridges shall be built until the plan and location thereof shall be approved by the Secretary of War; that should any change be made in the plans of said bridges, or either of them, during the progress of construction, such change shall be subject to the approval of the Secretary of War, and said structure

Changes.

or structures shall be changed at the cost and expense of the owners thereof from time to time as the Secretary may direct so as to preserve the free and convenient navigation of said rivers: *Provided*, That if either of said bridges is constructed as a drawbridge, the draw thereof shall be opened promptly upon reasonable signal for the passage of boats, and whatever kind of bridges shall be constructed the said company shall maintain thereon, from sunset to sunrise, such lights or other signals as the Light-House Board may prescribe.

Proviso. Draw.

Lights, etc.

SEC. 4. That this Act shall be null and void if actual construction of the bridges herein authorized be not commenced within one year and completed within three years of the date hereof.

Commencement and completion.

SEC. 5. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Amendment, etc.

Approved, January 25, 1895.

CHAP. 54.—An Act To authorize the Laporte, Houston and Northern Railroad Company to construct and maintain a bridge across Galveston Bay, Buffalo Bayou, and Clear Creek, in the State of Texas.

February 1, 1895.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Laporte, Houston and Northern Railroad Company, incorporated by the State of Texas and now existing under the laws of said State, is hereby authorized to construct, operate, and maintain, a bridge across Galveston Bay at or near Virginia Point, and across Clear Creek at a point between the bridge of the Galveston, Houston and Henderson Railroad and the mouth of the said creek at Clear Lake, and across Buffalo Bayou at any point from Clinton to the city of Houston, subject to the laws of the State of Texas, and upon the following terms, limitations, and conditions:

Laporte, Houston and Northern Railroad Company may bridge Galveston Bay, Buffalo Bayou, and Clear Creek, Tex.

First. That the precise location of said bridges shall be subject to the approval of the Secretary of War.

Location.

Second. Said company may locate, construct, and maintain over such bridges and approaches thereto railroad tracks for the use of railroads: *Provided*, That any railroad on either side of said bridges shall be permitted to connect its tracks with the said bridge approaches, and shall have equal rights of transit for its rolling stock, cars, passengers, and freight upon equal and equitable terms, and if a dispute as to the equality or equity of the terms shall arise it shall be submitted to and decided by the Secretary of War.

Railway bridge.

Proviso.

Use by other roads.

Third. That any bridge built under the authority of this Act shall be constructed with such span and at such elevation as the Secretary of War shall approve and require.

Spans, etc.

Fourth. That the said company, availing itself of the privilege of this Act, shall file with the Secretary of War an acceptance of its terms, and within six months after the passage hereof shall submit to him drawings, showing

Secretary of War to approve plans, etc.

plans and specifications and designated location, and shall
Completion. within two years of the passage of this Act complete said bridges, and unless said bridges shall be constructed within said time this Act shall be null and void as to any bridge not so constructed.

Opening draw. Fifth. That if any bridge herein authorized shall be built as a drawbridge, said draw shall be opened promptly, upon reasonable signal, for the passage of vessels and other water craft; and whatever kind of bridges are constructed
Lights, etc. the said company shall maintain thereon, at its own expense, from sunset to sunrise, such lights and other signals as the Light-House Board may prescribe.

Amendment, etc. SEC. 2. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Approved, February 1, 1895.

February 8, 1895. **CHAP. 62.**—An Act Authorizing the El Reno Bridge Company to construct a bridge across the South Canadian River, between Blaine County, Oklahoma, and the Wichita Indian Reservation.

Be it enacted by the Senate and House of Representatives
El Reno Bridge Company may bridge South Canadian River, Okla. *of the United States of America in Congress assembled*, That the El Reno Bridge Company, a corporation duly organized and existing under the laws of the Territory of Oklahoma, and its successors or assigns, be, and are hereby, authorized to construct and maintain a bridge and approaches thereto
Location. across the South Canadian River, between a point in Blaine County and the Wichita and Caddo Indian Reservation, in the Territory of Oklahoma, on section twenty-eight, township thirteen north, of range eleven west; said bridge shall be constructed to provide for the passage of wagons and vehicles of all kinds, for the transit of animals, foot passengers, and all kinds of commerce, travel, and communications, and said corporation may charge and receive such
Tolls. reasonable tolls therefor as may be permitted by the laws of the Territory of Oklahoma.

Lawful structure and post route. SEC. 2. That the bridge constructed under this Act shall be a lawful structure and shall be recognized as a post route, upon which no charge shall be made for the transmission over the same of the mails, troops, and munitions of war of the United States; and equal privileges in the use of said bridge
Postal telegraph. shall be granted to all telegraph companies; and the United States shall have the right of way across said bridge and
Provisos. approaches for postal telegraph purposes: *Provided*, That
Secretary of War to approve plan, etc. before the construction of any bridge herein authorized is commenced the said company shall submit to the Secretary of War, for his examination and approval, a design and drawing of such bridge and a map of the location, giving sufficient information to enable the Secretary of War to fully and satisfactorily understand the subject, and unless the plan and location of such bridge are approved by the
Free navigation. Secretary of War the structure shall not be built: *Provided also*, That any bridge constructed under authority of this Act shall at all times be so kept and managed as to offer reasonable and proper means for the passage of vessels and

other water craft through or under said structure; and for the safety of vessels passing at night there shall be displayed on said bridge, from sunset to sunrise, such lights or other signals as may be prescribed by the Light-House Board. Lights, etc.

SEC. 3. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the approval of this Act. Commencement and completion.

SEC. 4. That Congress shall have power at any time to alter, amend, or repeal this Act, or any part thereof, if in its judgment the public interests so require. Amendment, etc.

Approved, February 8, 1895.

CHAP. 80.—An Act To establish a national military park at Gettysburg, Pennsylvania. February 11, 1895.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War is hereby authorized to receive from the Gettysburg Battlefield Memorial Association, a corporation chartered by the State of Pennsylvania, a deed of conveyance to the United States of all the lands belonging to said association, embracing about eight hundred acres, more or less, and being a considerable part of the battlefield of Gettysburg, together with all rights of way over avenues through said lands acquired by said association, and all improvements made by it in and upon the same. Gettysburg National Park. Acceptance of land from Battlefield Memorial Association.

* * * * * * *

SEC. 8. That the Secretary of War is hereby authorized and directed to cause to be made a suitable bronze tablet, containing on it the address delivered by Abraham Lincoln, President of the United States, at Gettysburg on the nineteenth day of November, eighteen hundred and sixty-three, on the occasion of the dedication of the national cemetery at that place, and such tablet, having on it besides the address a medallion likeness of President Lincoln, shall be erected on the most suitable site within the limits of said park, which said address was in the following words, to wit: Bronze tablet containing Lincoln's address, etc. Medallion.

"Four score and seven years ago our fathers brought forth on this continent a new nation, conceived in liberty and dedicated to the proposition that all men are created equal. Inscription.

"Now we are engaged in a great civil war, testing whether that nation, or any nation so conceived and so dedicated, can long endure. We are met on a great battlefield of that war. We have come to dedicate a portion of that field as a final resting place for those who here gave their lives that that nation might live. It is altogether fitting and proper that we should do this.

"But, in a larger sense, we can not dedicate, we can not consecrate, we can not hallow this ground. The brave men, living and dead, who struggled here, have consecrated it far above our poor power to add or detract.

The world will little note, nor long remember, what we say here; but it can never forget what they did here. It is for us, the living, rather to be dedicated here to the unfinished work which they who fought here have thus far so nobly advanced. It is rather for us to be here dedicated to the great task remaining before us; that from these honored dead we take increased devotion to that cause for which they gave the last full measure of devotion; that we here highly resolve that these dead shall not have died in vain; that this nation, under God, shall have a new birth of freedom, and that government of the people, by the people, for the people, shall not perish from the earth."

Appropriation for tablet and medallion.

And the sum of five thousand dollars, or so much thereof as may be necessary, is hereby appropriated, out of any money in the Treasury not otherwise appropriated, to pay the cost of said tablet and medallion and pedestal.

* * * * * * *

Approved, February 11, 1895.

February 12, 1895.

CHAP. 83.—An Act Making appropriations for the support of the Army for the fiscal year ending June thirtieth, eighteen hundred and ninety-six, and for other purposes.

Army appropriations.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and they are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for the support of the Army for the year ending June thirtieth, eighteen hundred and ninety-six:

* * * * * * *

MISCELLANEOUS.

* * * * * * *

Public buildings, etc., D. C.

For additional pay to officer in charge of public buildings and grounds in Washington, District of Columbia, one thousand dollars.

* * * * * * *

Engineer Department.

ENGINEER DEPARTMENT.

Incidental expenses.

Engineer depot at Willets Point, New York: Incidental expenses of the depot, including fuel, lights, chemicals, stationery, hardware; extra-duty pay to soldiers necessarily employed for periods not less than ten days as artificers on work in addition to and not strictly in line of their military duties, such as carpenters, blacksmiths, draftsmen, printers, lithographers, photographers, engine drivers, teamsters, wheelwrights, masons, machinists, painters, overseers, laborers; repairs of and for materials to repair public buildings, machinery, and unforeseen expenses, four thousand dollars.

Materials.

For the purchase of materials for the instruction of engineer troops at Willets Point in their special duties as sappers and miners, for land and submarine mines,

and pontoniers, torpedo drill, and signaling, five hundred dollars.

For purchase and repair of instruments to be issued to officers of the Corps of Engineers, and to officers detailed and on duty as acting engineer officers for use on public works and surveys, two thousand dollars. Instruments.

* * * * * * *

Approved, February 12, 1895.

CHAP. 98.—An Act To bridge the Newark Bay. Febrnary 18, 1895.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the boards of chosen freeholders of the counties of Hudson and Union, in the State of New Jersey, or the legally constituted authorities of the city of Bayonne and the city of Elizabeth, as may be determined by the authorities of the State of New Jersey, shall be, and they are hereby, authorized to locate, build, maintain, equip, and operate a bridge across Newark Bay, in the State of New Jersey, between the city of Elizabeth, in the county of Union, and the city of Bayonne, in the county of Hudson, at a point not less than five hundred feet above the present bridge structure known as the Central Railroad bridge: *Provided*, That the bridge herein authorized shall be built as a drawbridge, with a draw giving a clear width of opening of not less than one hundred feet and said bridge shall be located and built in such manner and under such regulations for the security of navigation as the Secretary of War may prescribe; and to secure that object the parties proposing to build said bridge shall submit to the Secretary of War, for his examination and approval, a design and drawing of the bridge and a map of the location, and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be commenced or built; and should any change be made in the plans of said bridge during the progress of its construction, such changes shall be subject to the approval of the Secretary of War and the said bridge shall be held to be a public highway forever: *Provided also*, That the draw of said bridge shall be promptly opened, upon reasonable signal, for the passage of vessels and boats; and the owners of said bridge shall maintain thereon, from sunset to sunrise, such lights and other signals as the Light-House Board shall prescribe.

Newark Bay, N. J. Bayonne and Elizabeth may bridge.

Location.

Provisos.

Draw.

Secretary of War to approve plans, etc.

Opening draw.

Lights, etc.

SEC. 2. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the approval of this Act.

Commencement and completion.

SEC. 3. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Amendment, etc.

Approved, February 18, 1895.

February 25, 1895.

CHAP. 129.—An Act To authorize the construction of a bridge across the Missouri River in the county of Dakota, in the State of Nebraska, and in the city of Sioux City, in the county of Woodbury, in the State of Iowa.

Iowa and Nebraska Pontoon Bridge Company may bridge Missouri River, Sioux City, Iowa.
Laws, 2d sess. 53d Cong., p. 45.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Iowa and Nebraska Pontoon Bridge Company, a corporation organized under the laws of the State of Iowa, its successors and assigns, be, and they are hereby, authorized to construct a wagon bridge across the Missouri River between the State of Nebraska and the State of Iowa, within the county of Dakota, in the State of Nebraska, and the city of Sioux City, in the county of Woodbury, in the State of Iowa, and to build, erect, and lay on and over said bridge ways for wagons, vehicles of all kinds, and for the transit of animals; to provide ways for foot passengers, and to lay on and over said bridge tracks, upon which may be operated street railways; and to maintain and operate said bridge for the purposes aforesaid, and for all other uses and purposes incident to the use of a wagon bridge not specially enumerated; and to charge, collect, and receive reasonable

Tolls, etc.

compensation and tolls for the transit over said bridge of all wagons, carriages, vehicles of all kinds, persons, foot passengers and animals, street railways, and for all other uses

Provisos.

of said bridge not specially enumerated: *Provided*, That

Rules, etc.

the Secretary of War may at any time prescribe such rules, regulations, and rates of toll for transit and transportation over said bridge as may be deemed proper and reasonable:

Use by street railways.

Provided also, That all street railway companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of cars over the same and over the approaches thereto, upon payment of reasonable compensation for such use, and in case of any disagreement between the parties regarding the compensation to be paid or the conditions to be observed, the matters at issue shall be decided by the Secretary of War upon proper hearing.

Draw.

SEC. 2. That said bridge shall be constructed as a pivot drawbridge, with two or more draws, as the Secretary of War may prescribe, which said draws shall span the main channels of the river and shall not be less than two hundred feet in the clear on each side of the central or pivot

Spans.

piers of the draws; and all other spans over the river shall not be less than two hundred and fifty feet in the clear, measured at low water; and said spans shall not be less than ten feet above high-water mark, measuring to the lowest part of the superstructure of the bridge; and the piers of said bridge shall be parallel with the current of the river at high water.

Secretary of War to approve plans, etc.

SEC. 3. That no bridge shall be erected or maintained under the authority of this Act which shall at any time substantially and materially obstruct the free navigation of said river; and that no bridge shall be commenced or built under this Act until the location thereof and the plans and specifications for its construction shall have been submitted to and approved by the Secretary of War; and any

change in the plans of such construction or any alteration in the bridge after its construction shall be subject to the like approval; and that the Secretary of War is hereby authorized, whenever in his opinion the said bridge shall substantially obstruct the free navigation of said river, to cause such change or alteration of said bridge to be made as will obviate such obstruction; and all such alterations shall be made at the expense of the owner or owners of said bridge or the person operating or controlling same; and the said bridge shall be constructed with such aids to the passage of said bridge in the form of booms, dikes, piers, or other suitable and proper protections for confining the flow of water to a permanent and easily navigated channel for the guiding of rafts, steamboats, and other water craft safely through the draw as the Secretary of War shall prescribe and order to be constructed and maintained, at the expense of the company owning said bridge; and the said bridge shall be at all times so kept and managed as to offer reasonable and proper means for the passing of vessels through said structure; that said draw shall be opened promptly to its full width upon reasonable signal, without unnecessary delay, for the passage of vessels, steamboats, and other water craft requiring the opening of said draw for their safe passage; and the owners of said bridge shall maintain, at their own expense, from the hours of sunset to sunrise, such lights or other signals on said bridge as shall be prescribed by the Light-House Board.

Changes.

Aids to navigation.

Opening draw.

Lights, etc.

SEC. 4. That said corporation, or its successors, may, in conformity with plans approved by the Secretary of War, construct and maintain defensive and corrective works in or along said river, above or below said bridge, for the protection of the same and the approaches thereto, or for the improvement, correction, or control of the channel of said river.

Protective works.

SEC. 5. That any bridge built under this Act and according to its limitations shall be a lawful structure, and shall be recognized and known as a post route, upon which no higher charge shall be made for the transportation over the same of the mails, the troops, and munitions of war of the United States than the rate per mile paid for their transportation over the public highways leading to such bridge. The United States shall also have the right to construct, without charge therefor, telegraph and telephone lines across and upon said bridge.

Lawful structure and post route.

SEC. 6. That Congress may at any time alter, amend, or repeal this Act.

Amendment, etc.

SEC. 7. This Act shall take effect in one year after its approval, and shall be null and void if actual construction of the bridge be not commenced within one year and completed within three years from the date it takes effect.

Commencement and completion.

Approved, February 25, 1895.

February 26, 1895.

CHAP. 135.—An Act To authorize the construction of a bridge across the Yellowstone River, in the county of Dawson, State of Montana.

Dawson County may bridge Yellowstone River, Glendive, Mont.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the county of Dawson, in the State of Montana, is hereby authorized and empowered to erect, establish, and maintain, or authorize the erection, establishment, and maintenance of a wagon bridge across the Yellowstone River at a point suitable to the interests of navigation, from a point on the easterly bank of said river in the town of Glendive, in said county, so as to connect with the opposite shore of said river; that said bridge shall not interfere with the free navigation of said river beyond what is necessary in order to carry into effect the rights and privileges hereby granted.

Drawbridge.

SEC. 2. That the bridge under this Act shall be constructed as a pivot drawbridge, with the draw over the main channel of the river at an accessible and navigable point, and with a span of not less than one hundred feet in length in the clear on each side of the central or pivot pier of the draw, measured at right angles to the axis of the channel: *Provided*, That the said draw shall be opened promptly on reasonable signal for the passage of boats, vessels, and other water craft whose construction shall be such as not to admit of their passage under said bridge.

Proviso.
Opening draw.

Lawful structure and post route.

SEC. 3. That any bridge constructed under this Act and according to its provisions and conditions shall be a lawful structure, over which may be transmitted the mails, troops, and munitions of war of the United States free of charge; and the United States shall have the right of way for postal-telegraph purposes across said bridge.

Secretary of War to approve plans, etc.

SEC. 4. That the structure herein authorized shall be built and located under and subject to such regulations for the security of the navigation of said river as the Secretary of War shall prescribe, and to secure that object the corporation named shall submit to the Secretary of War, for his examination and approval, a design and drawing of the bridge and a map of the location giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the current, and the soundings, accurately showing the bed of the stream, and shall furnish such other information as shall be required for a full and satisfactory understanding of the subject; and until the said plans and location of the bridge are decided by the Secretary of War to be such as will not materially affect the interest of navigation the bridge shall not be commenced or built; and should any change be made in the plan of said bridge during the progress of construction such change shall be subject to the approval of the Secretary of War; and in case the approach and passage of the drawspan openings be found at any time dangerous or difficult of access by the river traffic, the persons owning said bridge shall construct, at their own expense, such works of channel regulation and

Changes.

such aids to navigation as the Secretary of War shall order, to render the approach and passage reasonably safe and easy; and the said structure shall at all times be so kept and managed as to offer reasonable and proper means for the passage of vessels through or under said structure; and for the safety of vessels passing at night there shall be displayed on said bridge, from the hours of sunset to sunrise, such lights as may be prescribed by the Light-House Board; and the said structure shall be changed or removed, at the cost and expense of the owners thereof, from time to time, as Congress may direct, so as to preserve the free and convenient navigation of said river; and the authority to erect and continue said bridge shall be subject to revocation and modification by law when the public good shall, in the judgment of Congress, so require, without any expense or charge to the United States.

Lights, etc.

Revocation, etc.

SEC. 5. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Amendment, etc.

SEC. 6. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date hereof.

Commencement and completion.

Approved, February 26, 1895.

CHAP. 149.—An Act To amend an Act entitled "An Act to authorize the Biloxi and Back Bay Bridge Company to construct and maintain a bridge over that portion of the bay of Biloxi, in the State of Mississippi, known as Back Bay."

March 1, 1895.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Act entitled "An Act to authorize the Biloxi and Back Bay Bridge Company to construct and maintain a bridge over that portion of the bay of Biloxi, in the State of Mississippi, known as Back Bay," approved August twenty-seventh, eighteen hundred and ninety-four, be, and the same is hereby, amended as follows: In section six, line two, strike out "one year" and insert instead thereof the words "two years."

Time extended for bridging Back Bay, Biloxi, Miss.
Laws, 2d sess. 53d Cong., p. 571.

Approved, March 1, 1895.

CHAP. 160.—An Act To authorize the Pittsburg and Mansfield Railroad Company to construct and maintain a bridge across the Monongahela River.

March 2, 1895.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Pittsburg and Mansfield Railroad Company, a corporation existing under the laws of the State of Pennsylvania, is hereby authorized to construct, maintain, and operate a railroad bridge across the Monongahela River between a point at or near the junction of Ferry and Water streets, in the city of Pittsburg, and a point on the opposite side at or near the line of Carson street, south side, in the city of

Pittsburg and Mansfield Railroad Company may bridge Monongahela River, Pittsburg, Pa.

Location.

Pittsburg, State of Pennsylvania; and said bridge, when built in accordance with the requirements of this Act, shall be a legal structure, and may be used for railroad and highway purposes.

Railroad, etc., bridge.

High bridge.

SEC. 2. That any bridge built under the provisions of this Act shall not be in any case of less elevation than eighty feet from the level of the water at pool full in said river to the bottom chord of said bridge, nor shall the main span be of less than seven hundred and fifty feet in length in the clear, and the piers of the bridge shall be parallel with the current of the river, and the main span shall be over the main channel of the river at ordinary water.

Secretary of War to approve plans, etc.

SEC. 3. That to secure a compliance with the conditions of this Act the company, previous to commencing the construction of the bridge, shall submit to the Secretary of War a plan of the bridge and the location of its piers, with a detailed map of the river at the proposed site of the bridge and for a distance of three-fourths of a mile above and below the site, exhibiting the depths and currents at all points of the same and the location of any other bridge or bridges, together with all other information touching said bridge and river as may be deemed requisite by the Secretary of War to determine whether the said bridge when built will conform to the provisions of this Act and cause no serious obstruction to the navigation of the river or injuriously affect the flow of water.

Notification of approval, etc.

SEC. 4. That the Secretary of War is hereby authorized and directed, upon receiving said plan and map, and upon being satisfied that a bridge built on such plan and at said locality will conform to the provisions of this Act and cause no serious obstruction to the navigation of the river or injuriously affect the flow of water, to notify the said company that he approves the same, and upon receiving such notification the said company may proceed to the erection of said bridge, conforming strictly to the proposed plan and location. But until the Secretary of War shall approve the plan and location of the said bridge, and notify the said company of the same in writing, the bridge shall not be built or commenced; and should any change be made in the plan of the bridge during the progress of the work thereon such change shall be subject likewise to the approval of the Secretary of War.

Changes.

Use by passengers, wagons, etc.

SEC. 5. That said bridge shall be constructed to provide for the passage of railroad trains and, at the option of the corporation by which it may be built, may be used for the passage of wagons and vehicles of all kinds for the transit of animals, and for foot passengers, for such reasonable rates of toll as may be approved from time to time by the Secretary of War.

Toll.

Use by other companies.

SEC. 6. That all railroad companies desiring the use of any bridge constructed under this Act shall have and be entitled to equal rights and privileges relative to the passage of railway trains or cars over the same, and over the approaches thereto, upon payment of reasonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any one of

Compensation.

of soundings, together with the number of the line, the average thickness of ice, and the length of time of all delay. The machine laborer was assisted in boring the holes by two of the laborers, one being required to turn the crank, one to feed the machine, and the third to mark the place for the next boring; the fourth laborer was designated as a flagman, and it was his duty to keep flags at the proper stakes to enable the men at the machine to keep on line. The flagman was also required to keep close watch of the sounding crew, and, as soon as they were through with one line of soundings, to have flags at the stakes on the next line, in order that there might be no delay.

In addition to these, there was one water-gauge reader and one extra laborer, whose duty it was to help the cook and to do general work about camp. The duty of the teamster was to take the men to and from work, to take their dinners to them when necessary on account of distance from camp, and to bring provisions, etc., to camp when required. The chief of party was constantly engaged in staking out work or going from one sounding crew to another to arrange the work to the best advantage.

Manner of doing the work.—In general, the azimuths were given from triangulation stations on shore to stakes on lines parallel to the general sailing lines of the channel. These lines were usually 1,000 feet either side of the center of the channel and then 3,000 feet apart to shore. The stakes were put in by transit intersection from the stations on shore and numbered and lettered—the number denoting the cross section and the letter the line. These stakes were placed 500 feet apart on the lines adjoining the channel, and on the other lines 1,000 feet apart.

Flag poles with flags were tied to each stake on a cross section by the flagman, and soundings taken every 50 feet along the line of flags. In order to measure the distance between the soundings, a piece of one-eighth inch wire bell cord 50 feet long was attached to each ice-boring machine. The machine being in place for the first sounding at one of the stakes, a mark was made in the snow, or on the ice, as the case may be, at a knot in the cord 50 feet ahead of the machine, being careful to keep on the line of flags. After the first hole was bored the machine was drawn to the mark made, the auger carefully centered over the mark, and the operation repeated. When the sounding party arrived at the first stake ahead, they checked up their distance. They should come to the stake with an even number of 50 feet, but owing to the marking on the snow or ice, and the difficulty of centering over the mark each time, they were quite frequently 2 or 3 feet from the stake. This was thought to be quite accurate enough, the distance between stakes usually being 3,000 feet.

The recorder and leadsman followed the ice-boring machine, the leadsman ascertaining the depth of water by use of the sounding reel. The sounding reel consists of a wheel 10 feet in circumference, graduated on its perimeter in feet and tenths of a foot, a fine wire with a lead attached to the end is wound on this wheel, and a dial is also attached to the wheel. This dial is set to read zero for the mean water surface when the lead is at the surface of the water. The whole is mounted on sleigh runners, and was pushed by the leadsman from one hole to another. The lead being lowered through the hole, the number of turns of the wheel was counted until the lead brought up on the bottom. This gave the number of 10 feet, and the amount more than a multiple of ten was taken from the perimeter of the wheel in feet and tenths of a foot. The number of turns was also counted in raising the lead as a check. The recorder also read the soundings as a check on the leadsman. By this means the depth of water was taken from the mean water surface without further reduction. The correction to get the mean water surface was obtained by the sounding crews at least twice each day, or oftener, if there was much change in the stage of water. This correction was applied to the soundings by setting the dial backward or forward from the zero mark the required distance when the lead was in contact with the surface of the water—the dial was set backward when the surface of the water was above and forward when it was below the mean stage. In taking each sounding, as soon as the lead touched the surface of the water it was stopped for an instant to see that the dial was in its proper place, and where snow had drifted on the ice the dial had to be moved slightly for nearly every sounding. This checking of the dial was also necessary to see that it had not shifted in position while going from one hole to another. It was found not to be disturbed, however, except when going over very rough ice.

The correction to be applied to the soundings was obtained from the water-gauge readings. A stake from 2½ to 3 inches in diameter was driven firmly into the ground in about 3 feet of water and near a bench mark whose elevation had been previously determined. A nail was driven into this stake and its elevation obtained by level readings from the bench mark. This nail was usually placed at the mean water surface, if the water was below the mean stage. The distance from this nail to the water surface gave the correction at once and is called a water-gauge reading. It was the duty of the water-gauge reader to obtain and record the water-gauge reading every fifteen minutes during the day, together with the direction and force of

wind. It was also his duty to see that the water-gauge stake was properly covered with brush and snow each night to keep ice from forming about it. Level readings were taken each morning from the bench mark to the nail in the water-gauge stake to make sure that its elevation had not changed.

Description of camp.—In selecting a location for camp, especial attention was paid to getting a place near to the work, well protected from the prevailing cold winds, with good water at hand and in the immediate vicinity of balsam trees and good wood for heating and cooking purposes. On arriving at the place selected, the snow was shoveled away and the cook's tent, three sleeping tents, and stable tent were put up. The walls of the sleeping tents were put close to the ground and covered on the outside with balsam boughs and snow to keep out the wind. A wall of canvas was put around the sleeping tents on the inside, and balsam boughs to the depth of 1 foot placed underneath the bedding, the bedding being furnished by each member of the party for himself. The tents were thus made to be very comfortable even in the coldest weather, and they had the advantage over other means of shelter of being easily handled so that they may be taken down, moved, put up, and everything in good shape in one day. On February 4 last, camp was moved a distance of 7 miles and everything in readiness at night, and during the night of February 4, the thermometer registered 32° below zero, and as no member of the party suffered from the cold this should be regarded as a good test of this way of living while at this work.

Area B was first staked out and sounded and additional soundings taken about the dock at Bay Mills. Area B is that part of Waiska Bay to the westward from the trestle crossing to Bay Mills from Superior. As there were no azimuths to stakes computed for this area, it was staked out with cross sections 500 feet apart at right angles to center line of trestle. Three lines of stakes, 50 feet, 1,000 feet, and 4,000 feet from the center line of the trestle, were placed on the even-numbered cross sections by measurement. Transit pointings were afterwards taken to flags at these stakes from △ K and △ L and their coordinates computed. This was done as a check on the measurement and to enable the cross sections to be platted more accurately. Transit pointings were also taken to flags and their coordinates computed in order to locate the soundings taken about the dock at Bay Mills. Additional soundings were also taken along the cross sections of area B extended eastward from the trestle, for the purpose of developing more fully the channel to the Bay Mills Dock, the channel through the draw of the trestle, and the bar at the mouth of the Waiska River. In sounding area B, as the sounding reels were not ready for use, the pole was used and the soundings afterwards reduced to the plane of reference.

While sounding area B simultaneous water-gauge readings were taken near camp and near the southern end of the trestle, and a bench mark established. This bench mark is the head of a nail driven into the root on the south side of a cedar tree 6 inches in diameter. This tree is on the shore of Waiska Bay and about 250 feet westerly from the southerly end of the railroad trestle. The elevation of this bench mark as determined from simultaneous water-gauge readings is 606.221 feet, this being the mean of two days' observations. All elevations are referred to the sea level at New York.

A line of levels was also run from P. B. M. No. 4, of the levels run from the canal to Waiska Bay, to the bench mark at the southern end of the trestle. The elevation of this bench mark as thus found was 606.307 feet.

The bench mark that was used near camp was the head of a nail driven into the root of a hemlock tree 10 inches in diameter. This tree is on the shore, about 300 feet easterly from the first point east of △ M, and south of Round Island. The elevation of this bench mark, as determined by simultaneous water-gauge readings with the bench mark at Round Island Light-house, in February, 1894, is 604.761 feet.

The elevation of the plane of reference of area B is 601.550 feet.

Area A was staked out and sounded from January 19 to February 2. In sounding area A the even-numbered cross sections, that is, lines 1,000 feet apart, were sounded from shore to shore to less than 6 feet of water, and the other cross sections were sounded to 2,500 feet either side of the center line of channel. Where the depth of water was less than 30 feet intermediate lines were sounded for 1,500 feet either side of the center line of channel. Where this was done the lines of soundings became 250 feet apart. Additional soundings were also taken to develop more fully the outline of the deep hole off the mission north of Bay Mills, and also to develop a shoal which was found near the Middle Ground Shoal.

In sounding area A ice was encountered which had been jammed in with a heavy sea and was from 6 to 10 feet thick in places. In order to get through this thick ice, ice chisels had to be used below the length of the auger, i. e., where the ice was more than 3 feet thick. Over a large part of this area small cakes of ice were jammed in edge wise and hindered the men in walking over it and in drawing the machines.

During the sounding of area A water-gauge readings were continued near camp. The elevation of plane of reference for area A is 601.550 feet.

On February 4 camp was moved from Waiska Bay to near △ P, about 4 miles west of Sault Ste. Marie, Mich.

Area E was staked out and sounded from February 5 to 8. In sounding area E the even-numbered cross sections were sounded from shore to shore to less than 6 feet of water. The remaining cross sections were sounded from 1,000 feet south to 4,000 feet north of the center line of channel, and intermediate cross sections were sounded within these limits where the depth of water was less than 30 feet. Soundings were also taken along transit lines running up the Big and Little Carp rivers for about 1,800 feet from the mouth of each stream, and these transit lines located with reference to triangulation stations.

Before beginning the sounding of area E, a bench mark was established near camp by simultaneous water-gauge readings with the bench mark at Point aux Pins. This bench mark near camp is the head of a nail driven into the root of an ash tree 7 inches in diameter. This tree is about 25 feet from shore and about 2,000 feet downstream from Solomon's place. The elevation of this bench mark as determined from the bench mark at Point aux Pins is 605.152 feet. During the sounding of area E continuous water-gauge readings were taken at camp. The elevation of the plane of reference for area E is 601.550 feet.

Area F was staked out and sounded from February 9 to 15. The azimuths to the stakes in this area were computed from △ 2 and △ 7, and in order to put them in by transit intersection it was necessary to sight across the open water at the head of the Rapids. Owing to the extreme cold weather this open water was constantly covered by a dense fog, so that after repeated attempts to put in these stakes it was necessary to recompute the azimuths, using △ 3 and △ 7 for a part of them and to put in the rest by measurement. This was necessary in order to keep the sounding parties at work. After staking out in this manner the stakes were read in by transit pointings from △ 2 and △ 7 on the first pleasant day, and their coordinates computed and found to agree with what they should have been very closely.

In sounding area F, all cross sections were sounded from shore to shore to less than 6 feet of water, and where the depth of water was less than 30 feet, intermediate cross sections were sounded from 1,000 feet south to 4,000 feet north of the center line of the channel. A part of these lines of soundings was cut off by the open water which extended from the Rapids up to Alexander's Mill Dock, covering an area of 0.54 square mile. Additional soundings were also taken about the docks at Alexander's Mill and Torrent's Mill. While sounding area F, particular care had to be taken as the ice was badly cracked and liable to break off and go over the Rapids.

Simultaneous water-gauge readings were taken at camp and at the head of the canal. The elevation of the bench mark at camp as thus determined is 604.853 feet, this being the mean of three days' observations. Water-gauge readings were continued at camp while sounding area F. The elevation of the plane of reference for area F is 601.550 feet.

On February 15 and 16 two sounding crews were engaged in taking the season's estimate soundings in the canal prism from 43 W to 110 W.

On February 16 camp was moved from near △ P to Little Rapids near bench mark A. Areas G and H were staked out and sounded from February 18 to 28. In sounding area G, all cross sections were sounded from shore to shore to less than 6 feet of water, and where the depth of water was less than 30 feet, soundings were taken along intermediate cross sections for 1,000 feet either side of the center line of channel. Additional soundings were also taken along all docks on both sides of the river. At the foot of the rapids considerable difficulty was found in taking the soundings, owing to the slush ice which had come over the rapids and had been carried underneath the solid ice. In places this ice was found to be 30 feet thick, this where the depth of water was from 35 to 40 feet. In order to take these soundings a 30-foot sounding pole had to be used after boring through the solid ice to make the hole for the lead. In these places the usual time for a sounding was about five minutes.

While sounding from the foot of the rapids to cross section 15, about opposite Spry's Dock, water-gauge readings were taken at the northeast pier. The elevation of the plane of reference for this part of the work is 584.270 feet. On and after February 26 continuous water-gauge readings were taken near bench mark A. The elevation of the plane of reference from cross section 16 to Little Rapids is 583.770 feet.

Area H was staked out and sounded from February 21 to 25. In sounding area H all cross sections were sounded from shore to shore to less than 6 feet of water. There was some open water above Island No. 4, and the same difficulty with slush ice was encountered as at the foot of the rapids in area G.

While sounding area H continuous water-gauge readings were taken at a stake at the lower end of the dredge cut through the island. The elevation of this water gate was determined from bench mark P. The elevation of the plane of reference for area H is 583.270 feet.

On March 1 hydrographic party No. 3, together with hydrographic party No. 2, Assistant Engineer Benno Rohnert in charge, went to Mud Lake for the purpose of continuing the hydrography down the river from Sailors Encampment. The two parties, with nine teams having the camping outfits, left Little Rapids at 4.15 a. m. and arrived at Mud Lake at 1 p. m. Camp was formed on St. Josephs Island, near Two Tree Island.

March 2 to 12 staking out and sounding area U and from the 13th to 14th staking out and sounding area V. On March 15 camp was moved from near Two Tree Island to Pointe aux Frênes. March 16 to 27, staking out and sounding areas W and X.

The azimuths from triangulation stations to stakes for areas U, V, W, and X were computed in camp, this work being done and the stakes put in in advance of the sounding parties. In sounding areas U, V, W, and X the even-numbered cross sections, i. e., lines 1,000 feet apart, were sounded from shore to shore to less than 6 feet of water. The remaining cross sections were sounded to 1,000 feet either side of the center line of channel, and where the depth of water was less than 30 feet intermediate cross sections were sounded within the same limits. In area W additional soundings were also taken about the dock at Raber, and to develop more fully a shoal which was found. This shoal was about 2,000 feet to the west of center line of channel and 2,000 feet south from Round Island, and is surrounded by water of a uniform depth of 22 or 23 feet. It is about 1,000 feet long north and south and 700 feet wide east and west. The least depth of water found on this shoal was 11 feet. The elevation of the plane of reference of areas U, V, W, and X is 581.478 feet.

The ice was found to be unsafe beyond area X, and on March 28 at 3 a. m. the hydrographic parties left Pointe aux Frênes with their camping outfits and arrived at Sault Ste. Marie at 1 p. m.

The total cost of subsistence of hydrographic party No. 3 while in the field was $585.61, not including the cook's wages, and $756.78 including the cook's wages. The total number of meals served during the season was 4,376. Cost per meal, not including cook's wages, is 13.4 cents; cost per meal, including the cook's wages, 17.3 cents. Average cost of subsistence per man during the season, not including the cook's wages, $25.46; average cost of subsistence per man during the season, including the cook's wages, $32.90. The number of days the party was subsisted in camp was sixty-seven. The number of days work was delayed on account of stormy weather, three.

The total cost of hydrography, including 10 per cent of the cost of the outfit, was $4,501.11.

The following table gives for each area sounded the number of square miles, the number of soundings, the cost of staking out, the actual work of boring the holes and sounding, the work of moving camp and working about camp on stormy days, and the total cost, together with the average cost per square mile of staking out, of the actual work of boring and sounding, and of the total cost, and the average cost per sounding:

Area.	Area.	Soundings.	Cost of staking out.	Cost of actual work of boring holes and sounding.	Cost of moving camp, etc.	Total cost.	Average cost per square mile.			Cost per sounding.
							Staking out.	Boring and sounding.	Total cost.	
	Sq. mi.									*Cents.*
A	15.15	9,108	$99.62	$627.98	$191.69	$919.29	$6.57	$41.45	$60.68	10.1
B	1.88	2,186	32.37	121.15	48.02	201.54	17.22	64.44	107.20	9.2
E	4.80	4,064	36.07	208.82	108.80	353.69	7.52	43.50	73.69	8.7
F	3.69	4,636	64.88	246.52	44.37	355.77	17.58	66.81	96.41	7.7
G	2.50	3,859	47.90	422.36	67.18	537.44	19.16	168.94	214.94	13.9
H	1	812	19.16	57.60	9.58	86.34	19.16	57.60	86.34	10.6
U	17.84	8,110	68.44	464.04	265.73	798.21	3.84	26.01	44.74	9.8
V	2.66	2,223	19.16	111.97	33.59	164.72	7.20	42.09	61.92	7.4
W	10.78	8,304	61.18	335.74	151.73	548.65	5.67	31.14	50.90	6.6
X	5	3,239	51.60	193.58	169.10	414.28	10.32	38.72	82.86	12.8
Total	65.30	46,541	500.38	2,789.76	1,089.79	4,379.93	7.66	42.72	67.07	9.4
Cost of season's estimate in canal						121.18				
Total cost						4,501.11				

From the above table it is seen that the average cost of staking out the work is 11.4 per cent of the whole cost; average cost of boring holes and sounding, 63.7 per cent of the whole cost, and average cost of moving camp and work about camp during stormy weather, 24.9 per cent of the whole cost. The average cost of hydrography per square mile is $67.07, and the average cost per sounding, 9.4 cents.

In boring the holes with the ice machines the average time per hole throughout the season from the time of beginning a line until the time of ending the same line was 46.3 seconds, i. e., the average time of drawing the machine 50 feet centering over the mark and boring the hole was 46.3 seconds. The average time per hole throughout the season, including the time taken to draw the machine from one line of holes to another, was 54 seconds.

Very respectfully, your obedient servant,

CHAS. Y. DIXON,
Assistant Engineer.

Mr. JOSEPH RIPLEY,
Assistant Engineer.

3.—REPORT OF MR. LAUCHLEN P. MORRISON, INSPECTOR.

UNITED STATES ENGINEER OFFICE,
Sault Ste. Marie, Mich., July 1, 1895.

SIR: I have the honor to submit the following report of the work done by hydrographic party No. 1 during the months of January, February, and March, 1895:

In compliance with your instructions of January 7, the party left the Sault at 8.30 a. m. on January 8 for the camp on Hay Lake, 7½ miles from the city. The camp equipage, consisting of two 14 by 14 foot, one 8 by 10 foot, and one 12 by 14 foot tents, complete outfit for the cook and mess tent, provisions for one week, feed for the team's and all the necessary bedding, was loaded on two sets of lumbermen's sleighs, the point selected being reached about 12.30; camp pitched and everything in good shape by 7 p. m.

Both teams were sent back to the Sault, one to remain there for further orders and the other one to return, bringing down the boring machines, sounding reels, and other necessary tools, this team remaining with the party during the time it was on the ice. The object of the work was to obtain fuller and more accurate hydrographic knowledge of the river for the construction of new charts. The party was what was known as a two-auger party, and consisted of a chief of party, 2 recorders, 2 leadsmen, 1 cook, 1 camp helper, and 10 laborers, or 17 men in all, one being a teamster in charge of the party team.

The disposition of the men was as follows: Each recorder had immediate charge of an auger party, consisting of himself, to record soundings made and to direct the operations of the party; one leadsman, to make the soundings; one machine man, having charge of the machine and the tools connected with the above machine; his duty also consisted of keeping records of the number of holes bored and the time occupied in boring them; he was assisted by two men; one flagman, whose duty it was to put up flags at the section stakes and other flags necessary for the machine man to keep his line by. In addition to these, there was a water-gauge man, common to both parties. His duty consisted of recording the elevation of the water surface every fifteen minutes, and also to seeing that the auger parties got the correction to add to the soundings as often as possible. The duty of the teamster with team was to carry the men out to work in the morning, in and out at noon if the party returned to camp for dinner, or to carry out lunch if the party remained on the work, and to bring them in at night, move the machines when necessary, and to carry the camp equipage from one camp ground to another. The duty of the cook is indicated by occupation. The helper aided the cook, kept the camp supplied with wood and water, and did other work necessary around the camp. The chief of party had general supervision and direction of the work.

The camp equipage consisted of one 14 by 14 foot cook tent (afterwards exchanged for a 12 by 14 foot); a No. 9 cook stove, with all the necessary utensils; three provision boxes; one folding table and sufficient folding benches to seat the party, and a full supply of tin plates, cups, etc., for the table; one 14 by 14 foot sleeping tent for the men, equipped with a No. 30 box stove; one 8 by 10 foot tent (afterwards exchanged for a 12 by 10 foot) for office tent and sleeping tent of the chief of party and recorders, equipped with one stationery box, one folding table, and a No. 24 box stove; one 12 by 14 foot (afterwards exchanged for a 14 by 14 foot, 12-ounce duck) tent, for a stable tent; all tents were supplied with flies, and sufficient canvas was issued to go all around the inside of each sleeping tent, forming a double wall; two ice-boring machines with augers; two sounding reels, with sufficient wire and leads; sight poles, signal flags, shovels (round and square nosed), axes (ship and round bit), and a tool box fitted with all the more common tools. The party had also two Buff and Berger transits, chain, steel tape, one Gurley level, and leveling rod.

The bedding was supplied by the men individually and was somewhat varied, but the quantity was always considerable.

In establishing a camp the cook tent was always of necessity the first placed, then the sleeping tents, and last the stable tent. The first operation was to shovel a

place sufficiently large to erect the cook tent and a fire started there as soon as possible; then the space was enlarged to contain the other tents, with the exception of the stable tent, which was always kept at some little distance from the others and handy to the road. After the tents were all erected, one party commenced getting balsam tops for the beds and a couple of men were detailed to construct a latrine sufficiently far away from camp to insure good sanitation. This latrine was an essential feature in a camp of over a day's duration.

After the balsam tops had been laid in to a depth of from 6 to 8 inches, the bedding was laid on top, and the pitching of camp completed.

The method of sounding an area was as follows: Three or more parallel lines of stakes were computed from suitable triangulation stations. The triangulation stations were occupied and the stakes put in at the intersection of two computed azimuths, and this method followed until the whole area was staked out. Sometimes two or three parties would be setting stakes, taking turns for direction from the two transit men at the station, and in this manner two or more parallel lines would be run in at the same time. After the area was staked out, or was sufficiently far advanced, one auger party would be started to bore and sound, and on completion of the transit work the other auger party would be started, soundings being taken as often as the importance of the work would warrant, generally 50 by 500 feet inside the channel line with additional 50 by 250 feet to develop the 30-foot curve, and 50 by 1,000 feet outside of the channel. A water gauge was always established before sounding was commenced, as near camp as practicable, and a man detailed to read during the time while soundings were being made.

A party making soundings would proceed as follows: The flagman would be sent ahead to put up the sight pole and flags at the section to be sounded. When these flags were up, the machine man would start his machine at some known line (stake line) and send his man ahead with the wire marked at 50 feet, and while the machine man and other laborer were boring the hole at the stake he would mark the point 50 feet from the machine and on line with the flags. The machine man would then move up to this mark and the lead man would go on ahead to mark another 50 feet. This operation being continued until the line was completed, checking the distance with the stake lines as they were intersected, the recorder, with the leadsman and reel, would follow the machine, sounding through the holes made by it and keeping as close as possible to stop the machine when far enough inshore, thus saving the auger from striking bottom. Striking bottom was one of the great delays in working in shoal water, as a very small amount of sand would spoil the cutting edge of auger. During the time this line was being bored the flagman had ranged out the next section and the work was continuous from this on until the completion of the area or of the portion staked out.

The machine used for boring the holes was known as an ice auger, and consisted of the ice auger (the essential part) and the frame for carrying and working it. The auger was a helix made from a three-fourths-inch square bar wound on a $1\frac{1}{2}$-inch mandrel to a $2\frac{1}{2}$-inch pitch; one end was forged into a cutting bit, and to give it clearance, made slightly wider both inside and out than the thickness of the steel bar. The helical form left an open central space through which the bored ice could come up. The other end was centered over the opening, turned, and a thread cut on it and fitted with a jam nut. The frame for carrying the auger consisted of a rectangular frame well braced and mounted on a pair of 3-inch runners 6 feet long. The device for working the auger consisted of a channeled drop bar 4 feet long, one end cut to receive the threaded end of the auger, which was screwed into the bar and held there by the jam nut; the other end was fitted with a swivel; this drop bar worked through a pinion of a $3\frac{1}{2}$ to 1 cut beveled gear. The frame was surmounted by a tripod rigged with a small single whip. The tripod was sufficiently high to raise the auger clear off the ice when not boring a hole. One end of the single whip carried a hook, fastening into the swivel on the drop bar, and the other was made fast into a ∪ clutch when the auger was not in use. The auger was turned by one man, and the machine man raised and lowered it by means of the whip. The machine was fitted with a length of wire bell cord, accurately marked at 50 feet. This cord was also used to aid in drawing the machine, it being moved by all three men together.

The Ripley-Haskell reel was the machine used to make the soundings. The reel was a device specially constructed for the hydrographic survey of St. Marys River, and it was found to be so convenient and accurate that the amount of work it will do in future is likely to be considerable. As the methods used heretofore were slow and not very accurate for soundings over 30 feet, it necessitated some better scheme for so general a work as the hydrographic resurvey of St. Marys River.

The reel consists of a wheel with the circumference accurately adjusted to 10 feet, an indicator for recording the number of turns made by the wheel, and a pointer for correcting the inequalities of the ice surface, and also to permit the correction for water surface to be added automatically, a frame and sleigh to carry and operate

the wheel, a 7-pound lead, and sufficient wire to reach the bottom in the deepest water expected to be met with on the river.

The periphery of the wheel was covered with sheet brass, over which the wire was wound; the wheel had rims of zinc extending above the brass, making a channel for the wire to run in; the outside of this rim was graduated to register feet and tenths; the remainder of the machine was of wood, with the exception of the axle. The hub carried a feather working into a cog wheel in the indicator and by this means every turn of the wheel was recorded by it. The indicator gave the even tens, and the pointer gave the odd feet and tenths, and a combination of the two gave the corrected sounding. The lead was the ordinary 7-pound sounding lead, and the wire used for sounding was plow steel, about 20 gauge, and capable of standing a strain of 400 pounds.

The work of the party consisted of taking hydrographic soundings and also the channel soundings for the season's estimate. The number of soundings taken by the party was 71,064, and of this number 39,813 soundings were for estimate work, and the remainder, 30,151, were hydrographic soundings. The amount of area covered by these soundings is 30.10 miles, or an average of 10,220 soundings per square mile. The average cost per square mile was $59.05, and the average cost per sounding 5.9 cents. The total cost of making the soundings was $1,777.48.

The greatest number of soundings taken in one day was 1,229, on February 26, 1895, area T, Little Mud Lake. This was done by the auger party under the charge of recorder J. B. Sawyer. The soundings were taken every 50 by 500 feet and the area covered was 1.1 miles, at a cost of $25; the sounding at this rate would be about 2 cents per sounding. The average thickness of ice over this area was 24 inches and the lines ran from shore to shore.

The total number of days the party was in the field was 80, and the number of working days 69.

DETAILED DESCRIPTION OF AREAS.

Area I.—This area was sounded from the east line of the dredged channel, Section IV, Division B, eastward to the east shore line. The soundings were 50 feet apart, and the section lines 500 feet apart; the portion from the east channel line to the west shore was included in the estimate and channel soundings. The total area in I is 3.20 miles, and the number of hydrographic soundings taken 1,835. The work on this area was done from the camp at the upper end of area J.

Area J.—The method pursued in sounding this area was the same as on area I; soundings 50 by 500 feet from shore to shore, but additional lines were run along longitudinal sections, to develop the 30-foot curve, these longitudinal lines being selected to cover the portion of the work needed. The West Neebish was not developed with the same minuteness. The soundings were 50 by 1,000 feet, with soundings made along the stake lines for additional development of the deep-water area. A line of soundings was run up the Charlotte River. Total area in J, 15.40 miles; number of soundings taken, 16,149. Camp was made twice for the completion of this area; once at the upper end, and the work completed down to 44, then camp was moved to the head of the Neebish Island at section 82, and the work completed down to 104. Open water was encountered at this point and the area was completed with the exception of five lines from the lower end.

Area K.—The upper portion of this area along the dike, Middle Neebish, was unsafe and was left; the lower portion from 130 down to 0 was sounded 50 by 250 feet, as the river is narrow here and special development was needed. Total area, 0.62 mile; number of soundings, 1,010. Some very thick ice was encountered at the upper end of the area, 5½ to 8 feet. This was caused by the ice breaking away in the open water area above and drifting under the ice below and freezing there. Considerable difficulty was also caused by the number of stones found in the ice; these, from their appearance, came from the dike. The ice in grinding along it had picked them up; the auger striking these stones delayed the party and did much damage to the cutting edge of the boring piece.

Area T.—This area was sounded 50 by 250 feet, the intermediate lines being carried all the way to shore. The area in T (Little Mud Lake) is 3.60 square miles, and the number of soundings taken was 4,986.

Area U.—The importance of this area warranted special development, and especially of the eastern portion from the east channel line of the American channel, Shoal 27, the channel work covering the remainder of the river at this point pretty thoroughly. The dock at Ross Landing and at the Encampment Mill was also very thoroughly developed. The area of this section is only 0.3 of a mile, and the number of hydrographic soundings taken was 3,151.

Area W.—The soundings on this area were taken every 50 feet on lines 1,000 feet apart. The portion assigned to party No. 1 was back of Lime Island, and in area amounted to 3.80 square miles, and the number of soundings was 1,248.

Area X.—The method pursued on area X was the same as on W, but the work was more scattered. The area completed by party No. 1 was 3.20 miles, with 1,777 soundings. Some contour work was done on area X by party No. 1.

METHOD OF RUNNING A CAMP, HYDROGRAPHIC PARTY NO. 1.

Provisions were obtained every week from the Sault either by the party team being sent after them, or by a special team being sent down with them, when the distance became so great that the party team would be absent more than one day. The breakfast call was generally 5.45 a. m. unless the distance to the work was great, or the camp had to be moved, when it would be somewhat earlier, depending on the object. By this means the party was generally ready to start at 6.30 and arrive at the work in good time. When the distance to work was over 3½ to 4 miles, it was more economical to move camp, but in some instances this was not the case. The lower end of area J, West Neebish, was a case of this kind. The whole area to be done was not over a day's work, so it was done from the camp Mosquito Bay, area U. An early start from camp, and lunch carried with the party, the work was completed in one day, whereas if camp had been moved it would have consumed two days, one to move camp, and the greater part of the next to do the work, and left a longer move to the next camp, at Pointe aux Frênes. Dinner or lunch was generally served at 12 m.; when the parties were working over a mile from camp it was found advisable to send lunch out on the ice, and to have dinner at night when the party returned to camp. Supper was generally served about 6 p. m., and light in the men's quarters out by 9 p. m , though there was no regulation to that effect. Lights in the office tents were generally going for an hour longer, looking over the work of the day and planning work for the next day.

The camps were comfortable even in the coldest weather. The furniture was simple; only what was essential was carried. Nearly all the dishes and utensils were of tin, making transportation easier and lessening the work of packing. For the keeping of vegetables and all perishable goods a small cellar was dug in the cook tent and covered over, and as the fire was kept going almost continuously in the cook tent very little trouble was experienced from frost. The meats were generally kept outside, hoisted up in a convenient tree. The food supplied was of good quality. The number of meals served during the time in the field was 3,600, at a cost of $513.73, making the cost per meal 14.24 cents. At this rate each man received 211.76 meals, and the cost of maintenance per capita for the winter, $30.22. Including the wages of the cook, the total cost would be $681.73, and this would make the cost per meal 18.936 cents, or 56.8 cents per ration. The teamster was boarded and lodged by the Government and shelter was furnished for the team, these conditions only holding good while the team was in camp. At all other times the teamster supplied both himself and the team. The feed and bedding for the team and means of transportation were furnished by the owner of the team without additional cost to the Government. The sleigh was also supplied with a sufficient number of goatskin robes and straw for the bottom of the sleigh box. The teamster, like all the other men in camp, furnished his own bedding. Two boxes were required by the terms of the contract, one rough box for the transportation of the camp equipage and one box with sufficient seats for the party in going to and from work. Board and lodging was furnished to no member of the party except during the time in camp.

The winter was favorable for the work, though the snow during the latter part of January and the fore part of February was deep and very soft, adding considerably to the difficulty of transportation and impeding the movements of the machines and the parties on the ice. Some very severe weather was encountered in the month of February, commencing on the 4th and lasting until the evening of the 10th, the temperature ranging from 20 to 38° below zero and blowing heavily all the time. Some severe frostbites were reported by members of the party. During part of the time it was impossible to pursue the work in the field, considerable difficulty being experienced during this time in the working of the instruments, and the metallic portions of the machines became very delicate on account of the extreme cold. This was especially true of the wire used for sounding.

This party was somewhat more expensive proportionately than the three-auger parties. As the cook received nearly the same wages ($5 less), this makes the meals somewhat higher, and a water gauge man was also needed at the same wages as in a three-auger party. In some ways, doing the work the party did, both channel work and hydrography, there were some advantages gained. As some of the stakes were common to both works, and camp had to be moved less often, while at other times the hydrography had to be laid over until the completion of the channel soundings.

Camp was made in five different locations during the winter; twice for the work on Hay Lake, one camp for the work on Little Mud Lake, one at Mosquito Bay for the encampment work and the upper end of area U, and the last camp at Pointe aux Frênes for the hydrography of areas W and X.

SURVEY OF THE N. & N.W. LAKES,
RESURVEY OF ST. MARYS RIVER,

Col. O.M. Poe, Corps of Eng'rs, Bvt. Brig. Genl. U. S.A.
in charge.

PLAN OF TRIANGULATION
AND
PROGRESS MAP.

Primary lines, directions measured ———
Primary lines, directions not measured – – – – –
Secondary lines, directions measured — · — · —
Secondary lines, directions not measured .....
Stations definitely located △
Stations approximately located ○
Completed topography ////////
Completed hydrography ::::::

Scale:
10 0 10 20 30 MILES.

1 EMERSON
2 TAQUAMENON (1867)
3 DOLLAR SETTLEMENT
4 IROQUOIS ISL.
5 N. GROS CAP
6 FOOTT (1868)
7 GOULAIS PT. (1895)
8 " " (1868)
9 MAPLE ISL.
10 RUDDER HEAD (1868)
11 " " (1895)
12 SOUTH SHORE (1868)
13 ROCK
14 EAST BAY
15 MIDDLE BATCHEWANA
16 SAND PT.
17 CRAWFORD
18 S. PANCAKE
19 MIDDLE PANCAKE
20 STEAMBOAT ISL.
21 N. SANDY (1868)
22 S. SANDY (1868)
23 N. PARISIAN
24 S. PARISIAN

PAUGON
MICHIPICOTEN
GARGANTUA
LAKE SUPERIOR
CARIBOU Id L.H.
MAMAINSE
BATCHEWANA BASE
CORBAY VT.
W. BASE
E. BASE.
N. SANDY
HAVILLAND
WHITEFISH
CRISP
PARISIAN
ROBBINS
PENNEFATHER
GROS CAP
RANKIN MT.
IROQUOIS
SALT POINT
LARKE
HAY LAKE
LAIRD
NEEBASH
DUKE
SALTERS HILL
WATER PT.
ROCKY PT.
PTE. AUX FRENES
BURNT PT.
BACON
HARBOR ISL.
RABER
FT. ST. JOS.
DRUMMOND
DETOUR
DETOUR LTO
LAKE MICHIGAN
LAKE HURON
E (RABBIT BACK)
D (ST. IGNACE)
C (MACKINAC Id)
A (W. BASE)
MACKINAC BASE
B' (E BASE)
SPECTACLE REEF LT.

July 4. 1895.

Respectfully submitted to Col. O.M. Poe with my annual report of this date

Charles S. Riché.
1st Lieut. Corps of Eng'rs. U. S.A.

A. MANGELSDORF

Eng 54 1

SURVEY OF THE N. & N.W. LAKES,

RESURVEY OF ST. MARYS RIVER,

Col. O.M. Poe, Corps of Engrs., Bvt. Brig. Genl. U. S.A.

in charge.

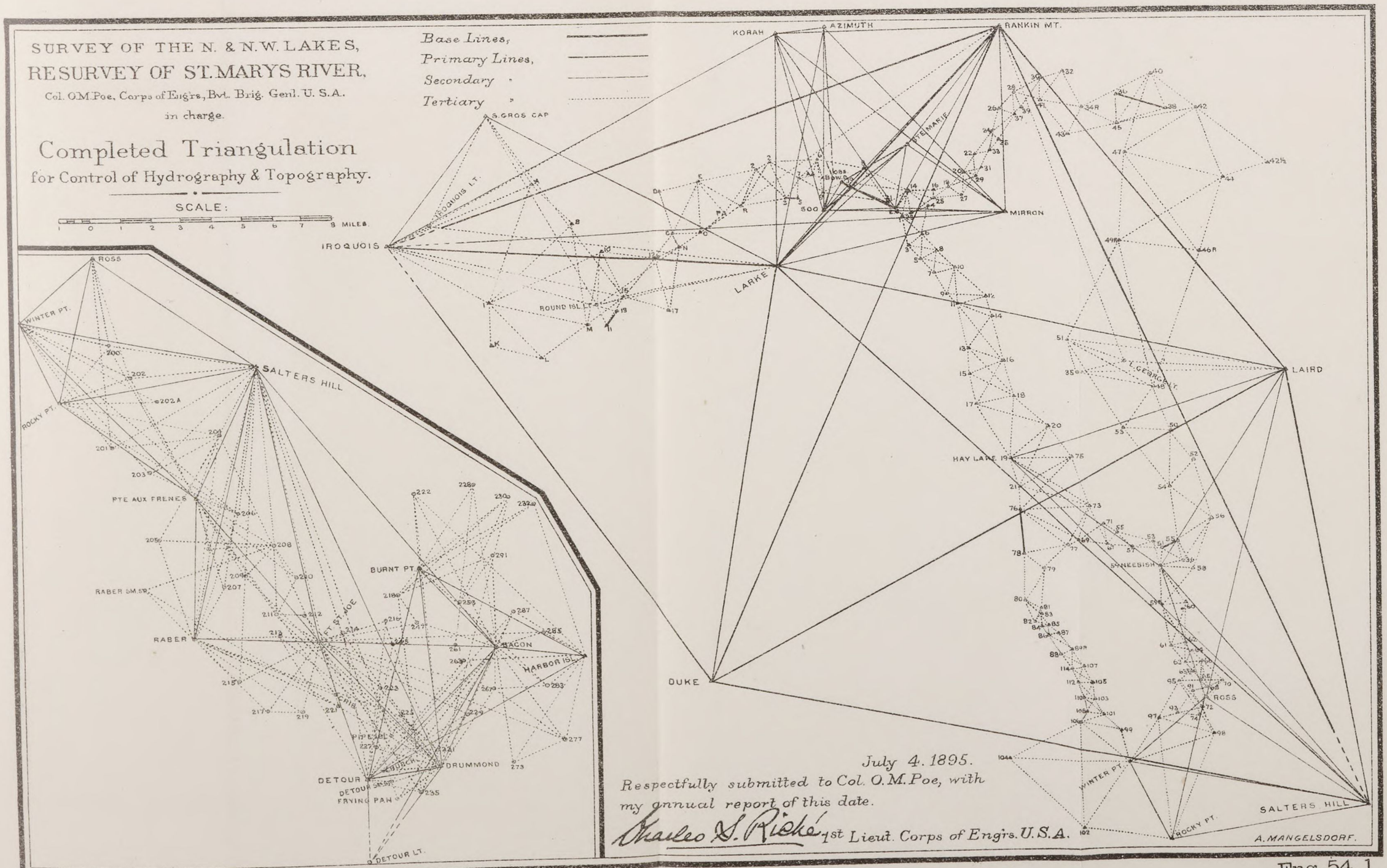
Completed Triangulation

for Control of Hydrography & Topography.

Base Lines,
Primary Lines,
Secondary "
Tertiary "

SCALE:

1 0 1 2 3 4 5 6 7 8 MILES.



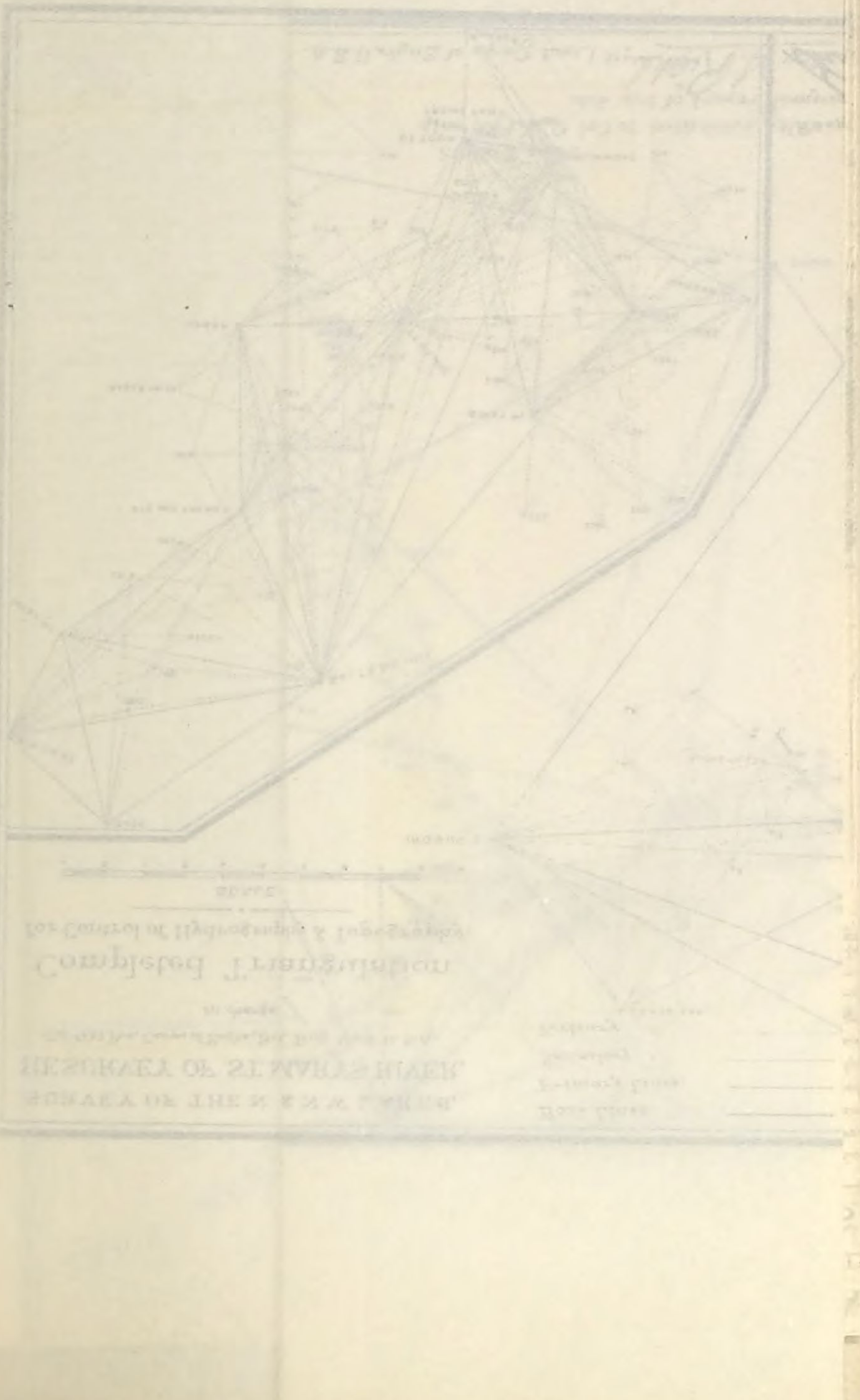
July 4. 1895.

Respectfully submitted to Col. O.M. Poe, with my annual report of this date.

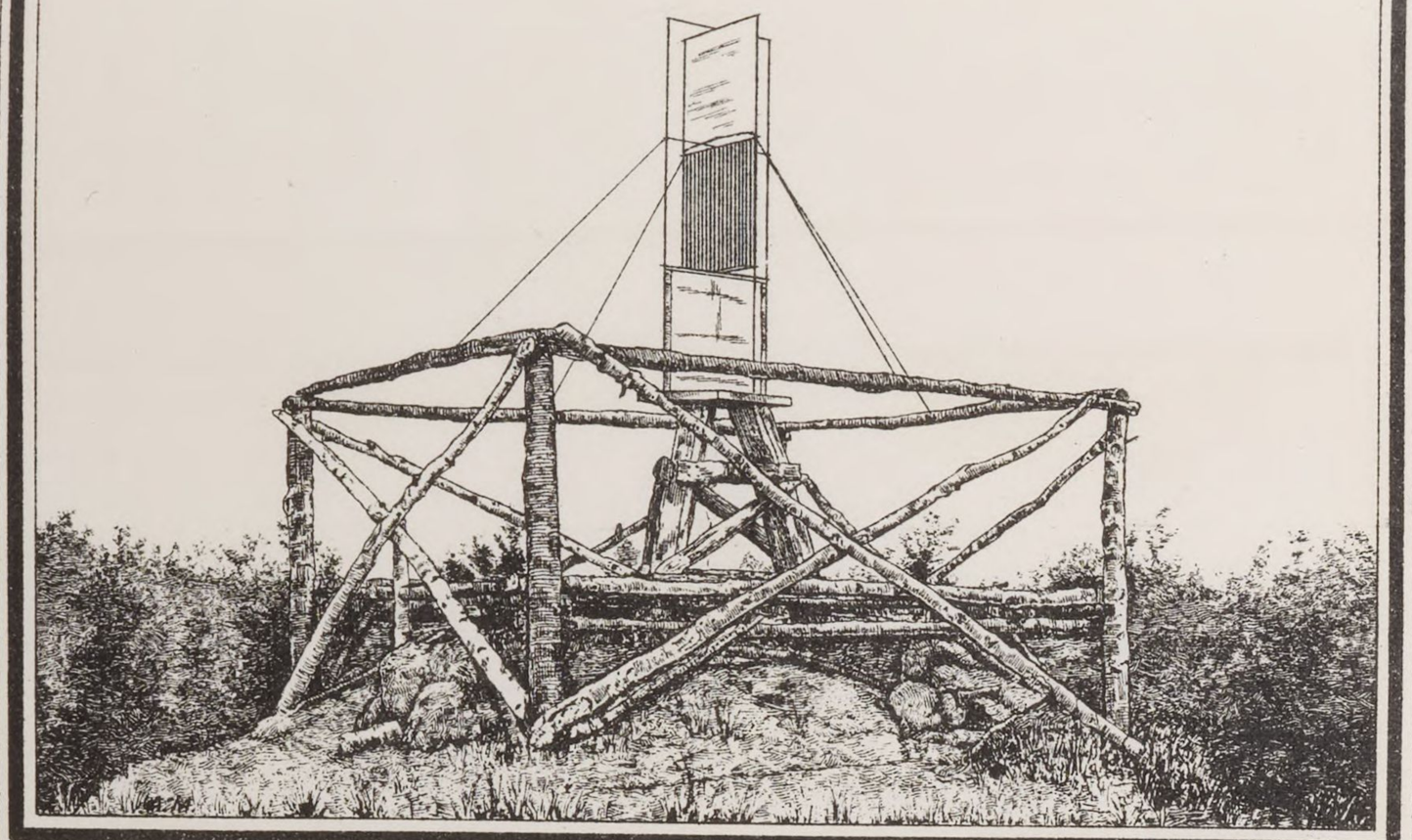
Charles S. Riché 1st Lieut. Corps of Engrs. U.S.A.

A. MANGELSDORF.

Eng 54 1



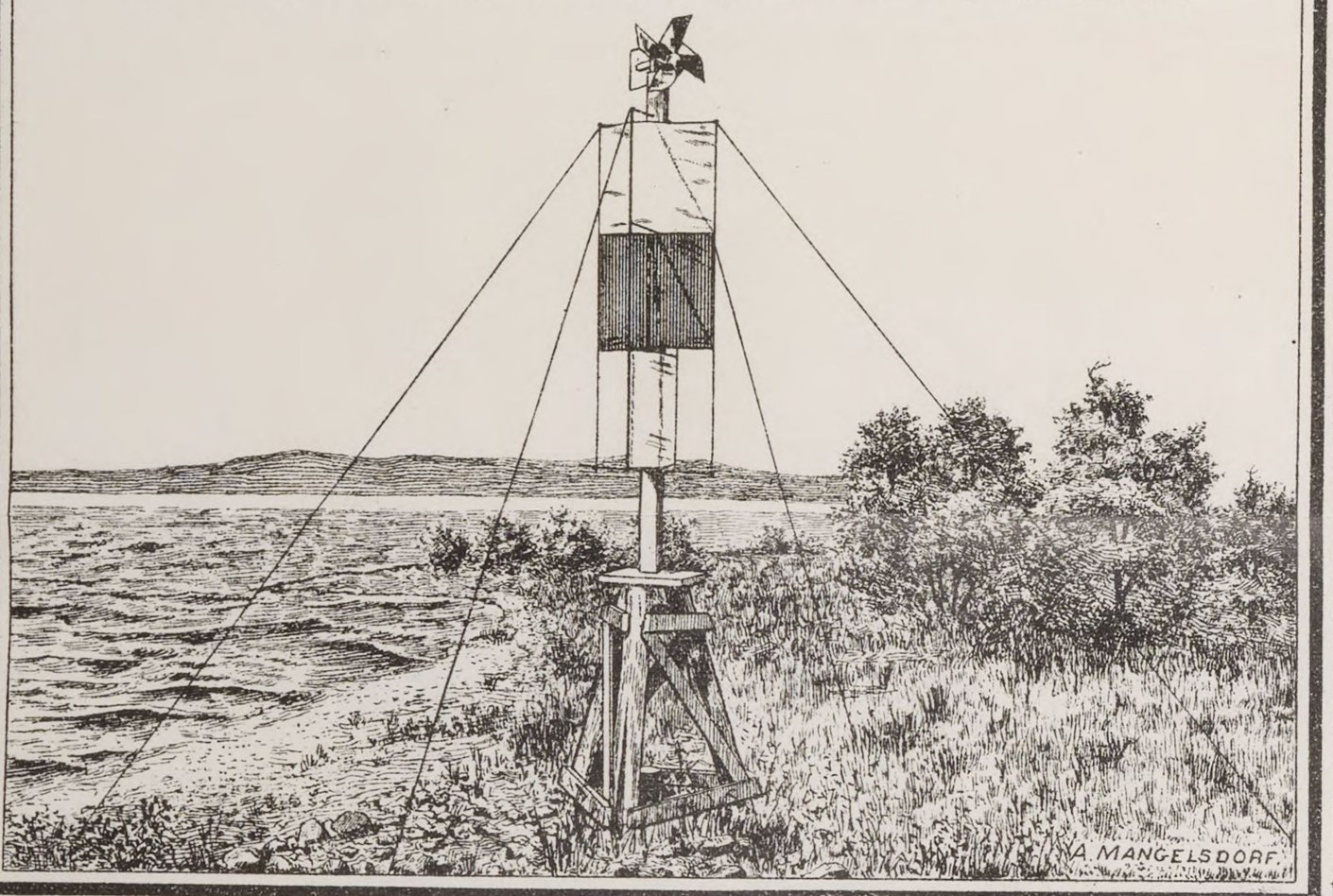
TARGET ON △ RANKIN MT.



SURVEY OF THE N. & N.W. LAKES,
RESURVEY OF ST. MARYS RIVER.

Col. O.M. Poe, Corps of Eng'rs., Bvt. Brig. Genl. U. S.A.
in charge.

CHARACTERISTIC FLAG STATION TARGET — FOR LONG LINES.



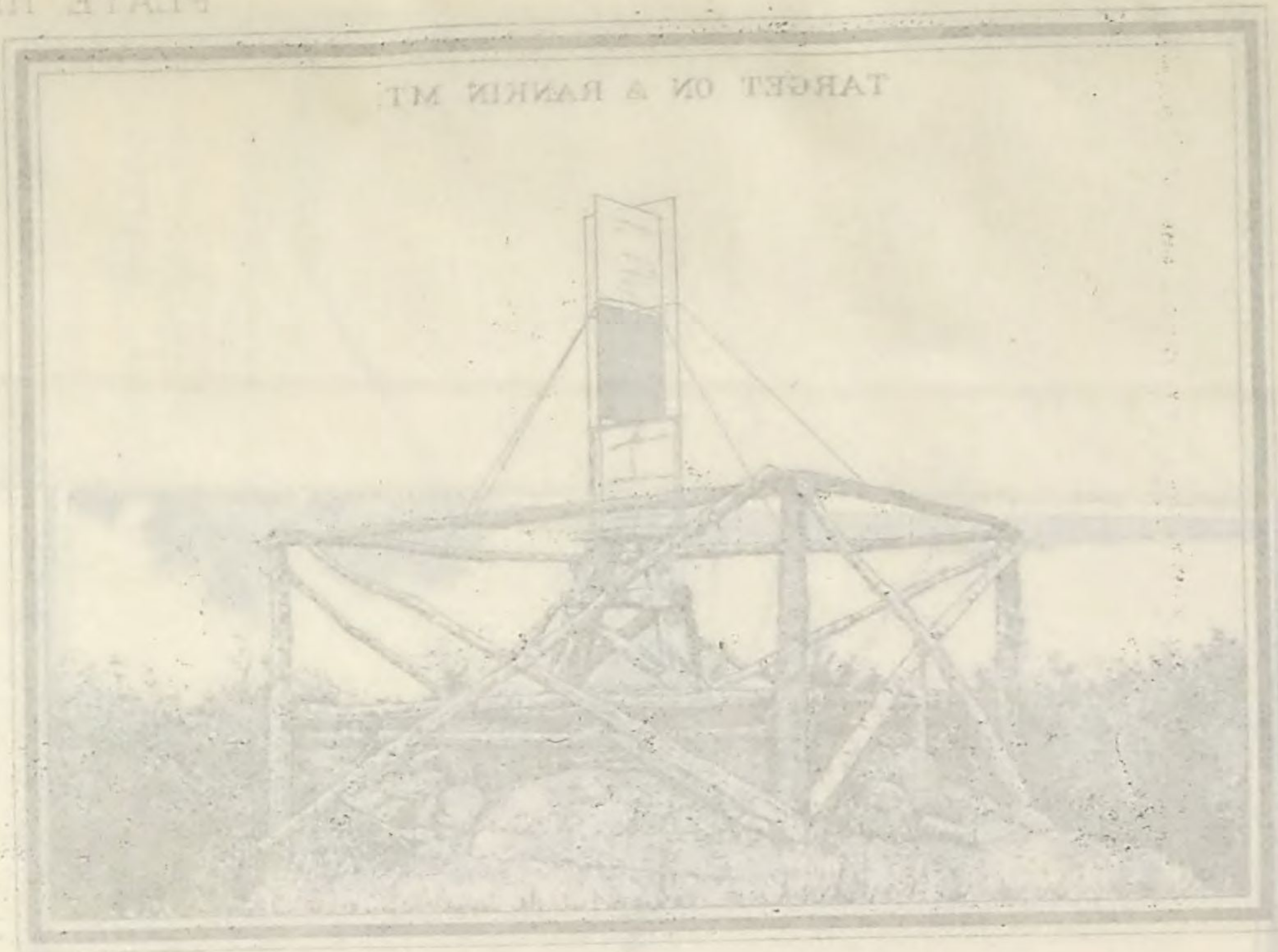
July 4. 1895. Respectfully submitted to Col. O.M. Poe, with my annual report of this date.

Charles D. Riché, *1st. Lieut. Corps of Eng'rs., U. S. A.*

Fng 54 1

PLATE III

TARGET ON A RANKIN MT.



SURVEY OF THE N. & N.W. LAKES,
RESURVEY OF ST. MARYS RIVER.

Col. O.M. Poe, Corps of Engrs., Bvt. Brig. Genl. U.S.A.

SURVEY OF THE N. & N.W. LAKES.
RESURVEY OF ST. MARYS RIVER.

Col. O.M. Poe, Corps of Eng'rs., Bvt. Brig. Genl. U. S.A.
in charge.

HYDROGRAPHIC SURVEYING IN WINTER.

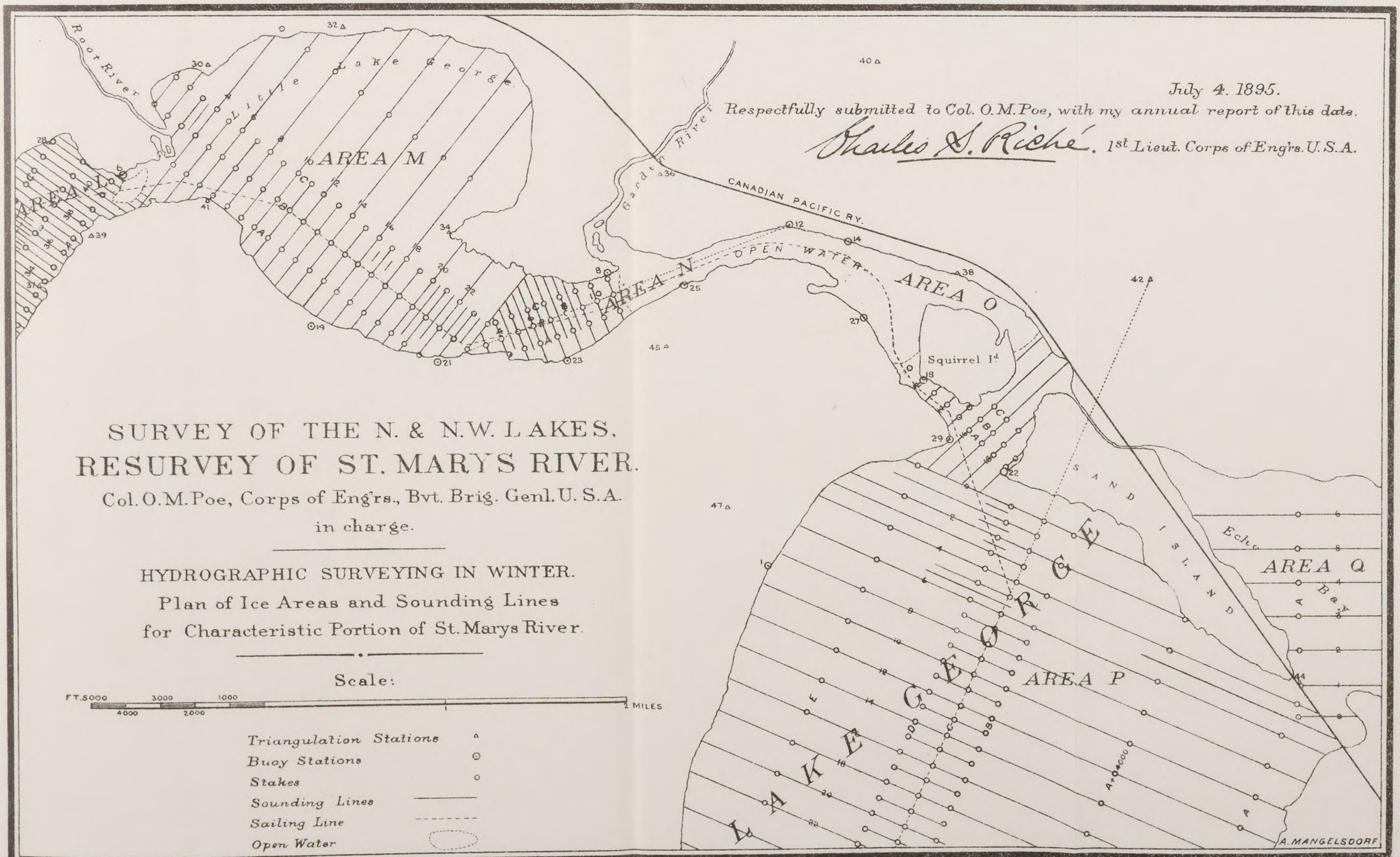
Plan of Ice Areas and Sounding Lines
for Characteristic Portion of St. Marys River.

Scale:

FT. 5000 3000 1000 0 1 2 MILES
4000 2000

Triangulation Stations △
Buoy Stations ⊙
Stakes ○
Sounding Lines ——
Sailing Line - - - - -
Open Water

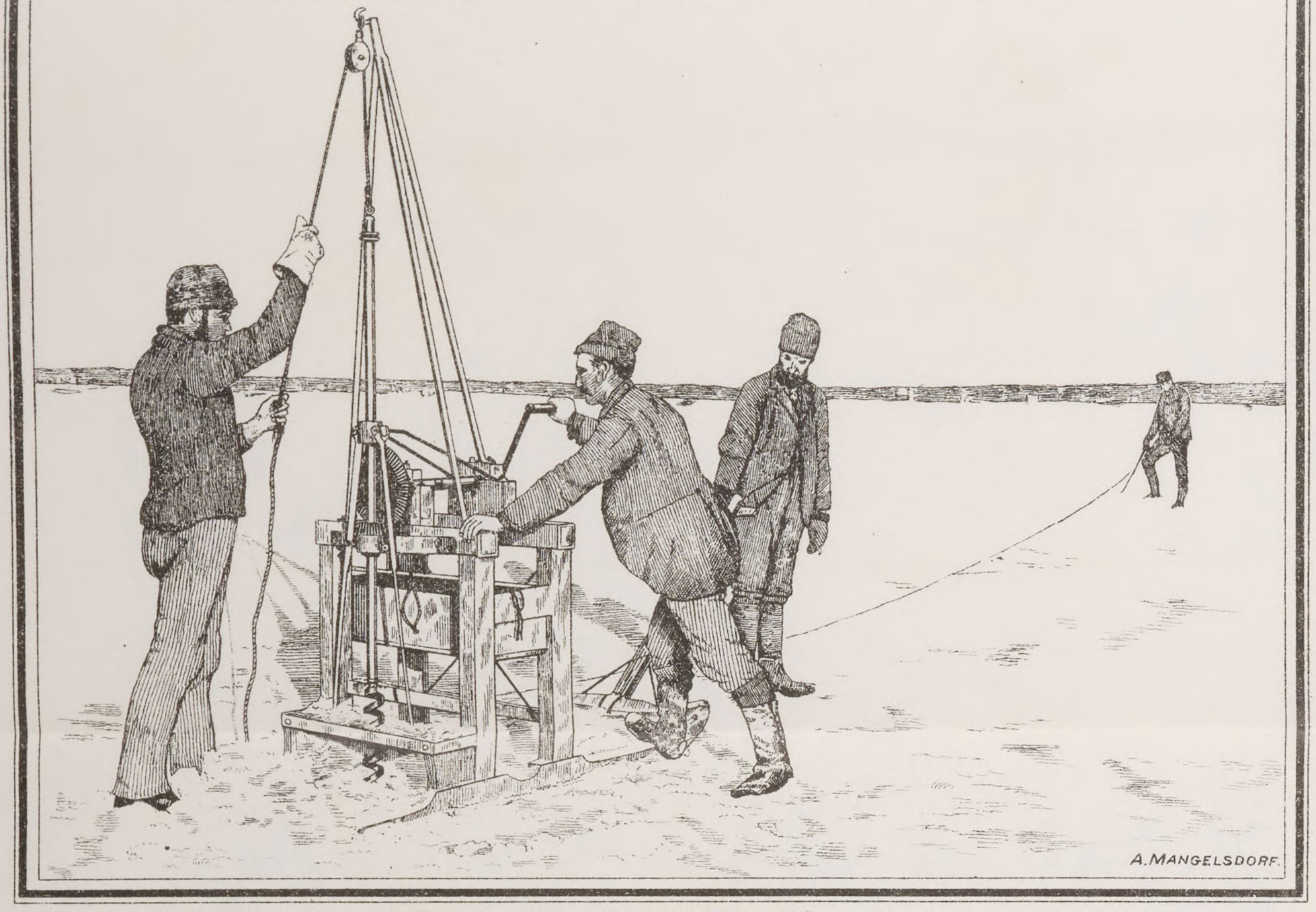
July 4. 1895.
Respectfully submitted to Col. O.M. Poe, with my annual report of this date.
Charles S. Riché. 1st Lieut. Corps of Eng'rs. U.S.A.



Eng 54 1

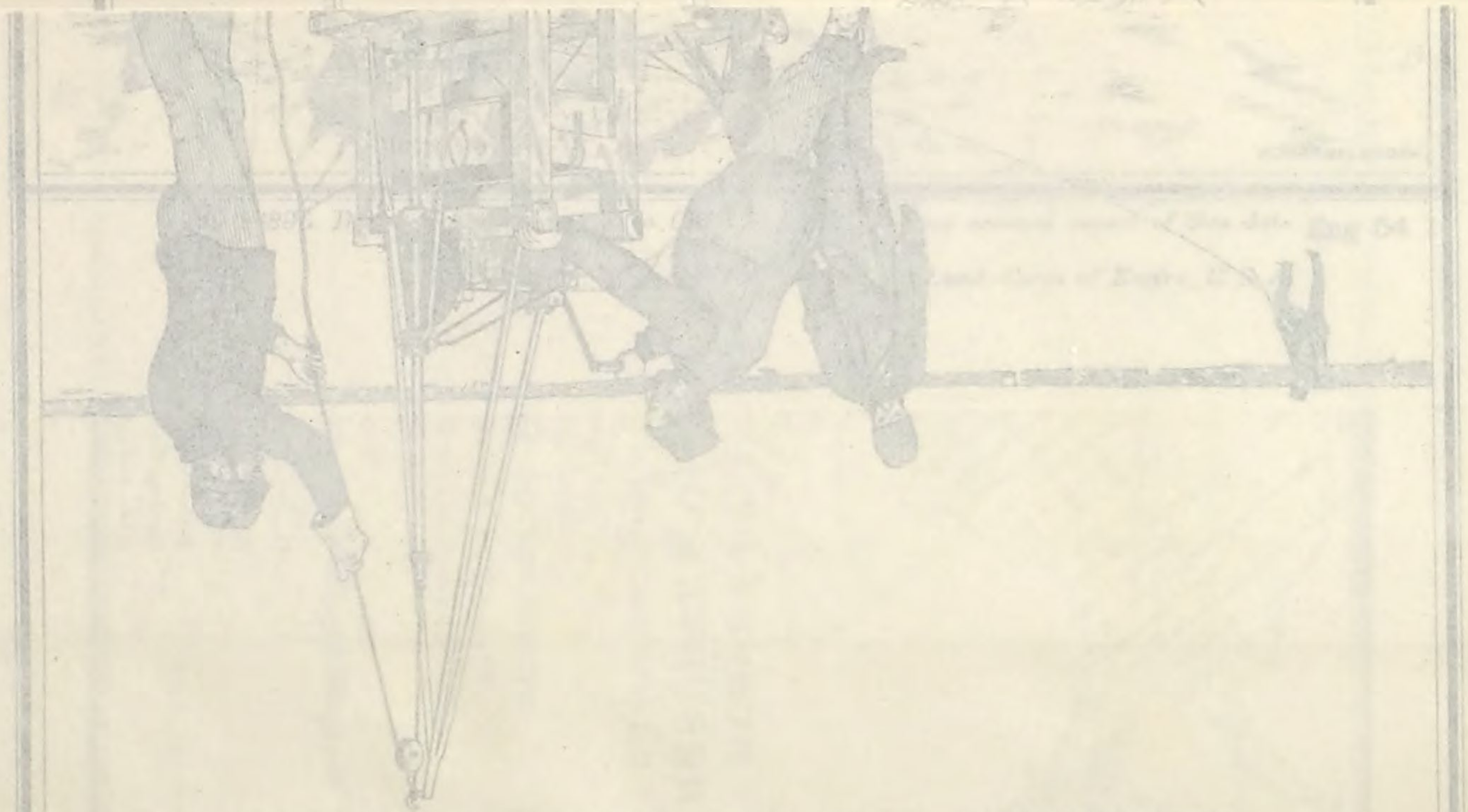
SURVEY OF THE N. & N.W. LAKES – RESURVEY OF ST. MARYS RIVER.

HYDROGRAPHIC SURVEYING IN WINTER. ICE BORING MACHINE.



July 4. 1895. Respectfully submitted to Col. O. M. Poe, with my annual report of this date. Eng 54 1

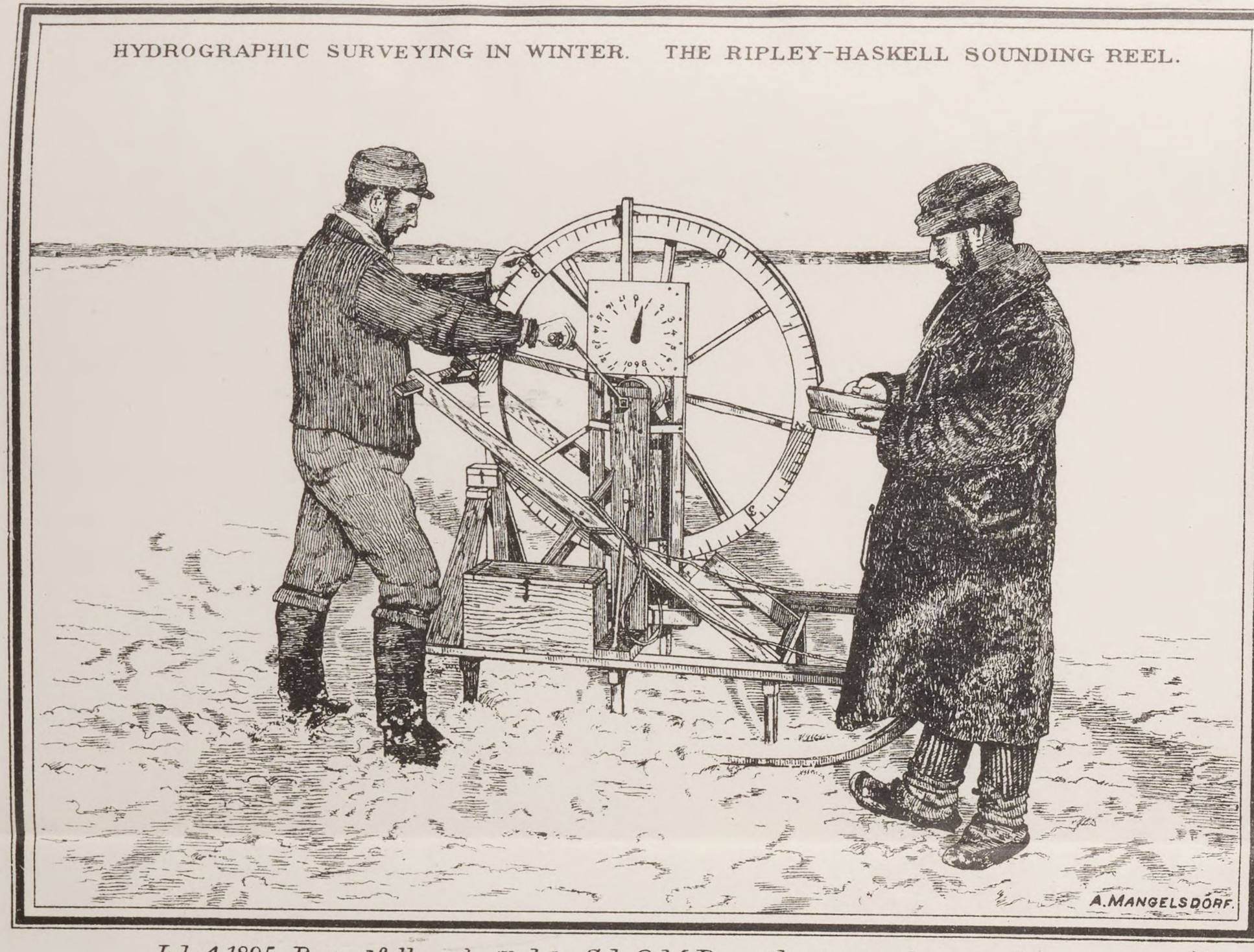
Charles S. Riché. *1st. Lieut. Corps of Eng'rs., U. S. A.*



HYDROGRAPHIC SURVEYING IN WINTER. ICE BORING MACHINE.

SURVEY OF THE N. & N.W. LAKES – RESURVEY OF ST. MARYS RIVER.

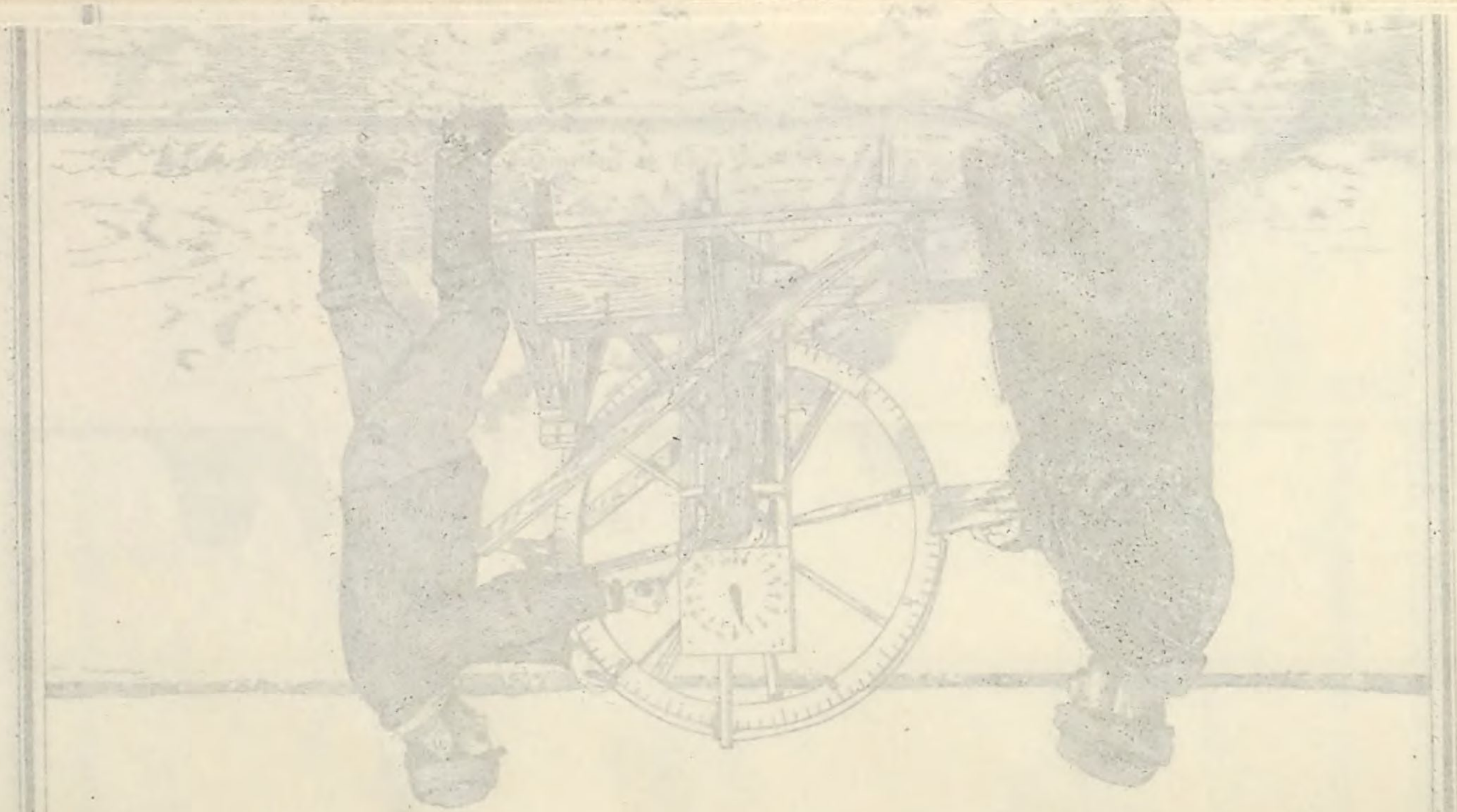
HYDROGRAPHIC SURVEYING IN WINTER. THE RIPLEY-HASKELL SOUNDING REEL.



July 4. 1895. Respectfully submitted to Col. O. M. Poe, with my annual report of this date.

Eng 54 1

Charles S. Riché. *1st. Lieut. Corps of Eng'rs., U. S. A*



HARBOR CHANNEL IN WINTER THE BILGER-HASKELL SOUNDING REEL

A small log house was found on the upper end of Neebish Island, where camp was made. This was used for the cook's tent, and was of some aid in establishing camp, but was found to be very cold, much colder than the tents were at the same time and place; the wood in this camp ground was also very poor. At Pointe aux Frênes the party was altogether camped in the houses of the old settlement. There the weather was somewhat warmer and no special inconvenience was experienced from the cold.

Considerable credit is due to the two recorders of the party, J. H. Sawyer and Henry Ohlschlager. They used their best endeavors to push the work along and displayed good judgment in handling the men intrusted to their charge, and a great deal of the progress of the winter's work is due to this factor; and the whole party is deserving of praise for their ready obedience to orders, the willing way they executed the work required of them, and the contented way they took the discomforts and hard knocks of the winter.

Table of areas and soundings.

Area.	Square miles.	Soundings.	Average soundings per square mile.	Remarks.
I.....	3.20	1,835	.....	This area partly covered by estimate soundings.
J.....	15.40	16,149	1,049	500-foot lines from shore to shore.
K.....	9.62	1,003	1,617	Do.
L.....	3.60	4,988	1,386	Do.
U.....	0.30	3,151	10,503	Soundings 50 by 10 on east of American channel.
W.....	3.80	1 248	328	Soundings 1,000 by 50.
X.....	3.20	1,777	555	Some contour work done on this area.
Total....	30.50	30,151	1,022	

Very respectfully, your obedient servant,

LAUCHLEN P. MORRISON, *Inspector.*

Mr. JOSEPH RIPLEY,
Assistant Engineer.

E E E 2.

REEXAMINATION OF ST. LAWRENCE RIVER.

REPORT OF CAPT. SMITH S. LEACH, CORPS OF ENGINEERS.

UNITED STATES ENGINEER OFFICE,
Burlington, Vt., July 1, 1895.

GENERAL: I have the honor to transmit herewith my annual report on the reexamination of the St. Lawrence River, under allotments of $3,500 and $250 from the appropriation for survey of the Northern and Northwestern Lakes, in act approved August 18, 1894.

Very respectfully, your obedient servant,

SMITH S. LEACH,
Captain, Corps of Engineers.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

SURVEY OF THE NORTHERN AND NORTHWESTERN LAKES.

[Allotment for reexamination of St. Lawrence River.]

Between Lake Ontario and Morristown, N. Y., a distance of 40 miles, including the whole of the stretch popularly known as the "Thousand Islands," the bed of the St. Lawrence is mostly of rock in situ, and by reason of a highly inclined stratification is of extremely irregular

conformation. Small shoals, with sides nearly vertical, may project many feet above the characteristic depth and yet lie wholly between two casts of the lead as ordinarily taken in hydrographic surveys. For such a stream the usual method of lead-line hydrography, no matter how carefully used, is inherently defective. Several shoals not disclosed by the original survey had been touched by vessels and reported, and it was determined to examine that part of the channel used by deep-draft vessels under such conditions as to leave no possibility of dangerous points of rock remaining undiscovered.

It was decided to employ the method of continuous sweeping, for many years in use in verifying the removal of rock to specified planes, but never before adapted to use on such a large scale and at reasonable cost. An allotment of $4,275 from the appropriation of same title in the previous year's bill was expended in constructing the apparatus, in discovering by tedious and somewhat costly experience the best manner of operating it, and in going over 9½ miles of the river.

From the appropriation for this fiscal year allotments of $3,500 and $250 were made for continuing the work. The best working season having passed when funds became available in the fall of 1894, it was decided to postpone the beginning of operations until the spring of 1895, and then begin above Alexandria Bay and complete a stretch of narrow river before the advent of pleasure crafts, which are so numerous as to greatly impede the work. The party was organized in the latter part of April, and after overhauling and repairing the apparatus reached the point of beginning on May 3. From that date until the close of the fiscal year work was prosecuted during all suitable weather, and the actual field work was completed, leaving only three or four days' work of dismantling and storing the apparatus to be done in the new fiscal year. But for time lost in the last week by accidents to the machinery of the steamer employed the operations would have been wholly confined to the fiscal year 1895.

But seven new shoals were found, and none of them dangerous, in the assumed channel limits over the entire distance traversed this year. This fact, together with the evident change in the character of the bed in approaching the lake, and the fact that sailing vessels with deep centerboards have traversed the upper part in every direction for years, convinced me that no obstructions exist above Blanket Island. This view was concurred in by the division engineer, who visited the locality and inspected the work, and the point named was therefore selected as the upper terminus. It is 4 miles above Clayton and 10 miles from the lake.

A brief and general description of the apparatus and method was given in the last annual report. The novel character and many interesting features of the undertaking will, it is thought, warrant the preparation of a full and detailed report, with drawings. Such a report can not be completed in time to be incorporated herein, but will be forwarded later for such disposition as the Department may see fit to make of it.

Money statement.

September 1, 1894, amount allotted	$3,500.00
July 3, 1895, amount allotted	250.00
	3,750.00
June 30, 1895, amount expended during fiscal year	2,160.06
July 1, 1895, balance unexpended	1,589.94
July 1, 1895, outstanding liabilities (estimated)	1,517.57
July 1, 1895, balance available	72.37

E E E 3.

ANNUAL WATER LEVELS OF THE NORTHERN AND NORTHWESTERN LAKES.

Tridaily observations were made at Charlotte and at Oswego, N. Y., on Lake Ontario, from July 1, 1894, to June 30, 1895; at Erie Harbor, Pennsylvania, Ashtabula and Cleveland, Ohio, and Monroe, Mich., on Lake Erie; at Milwaukee, Wis., on Lake Michigan, and at Escanaba, Mich., on Green Bay, from July 1 to December 30, 1894, and from April 1 to June 30, 1895.

Daily observations were made at Sand Beach, Mich., on Lake Huron, and at Sault Ste. Marie and Marquette, Mich., on Lake Superior, from July 1, 1894, to June 30, 1895.

The accompanying table is a continuation of that published in the Annual Report of the Chief of Engineers for 1894, Part VI, page 3430:

Monthly mean of water levels for the several stations below the planes of reference adopted in 1876.

Station.	1894.						1895.					
	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.	June.
	Feet.	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Charlotte	2.60	3.20	3.68	3.98	4.25	4.58	4.57	4.70	4.72	4.38	4.16	4.34
Oswego	2.50	3.08	3.59	3.84	4.17	4.52	4.61	4.67	4.77	4.23	4.10	4.22
Erie	2.24	2.68	2.90	3.00	3.15	3.33	3.41	3.82	3.79	3.83	3.55	3.49
Ashtabula	2.25	2.69	2.87	3.08	3.15	3.36	3.58	3.96	3.98	3.73	3.49	3.57
Cleveland	2.38	2.75	2.92	3.24	3.48	3.55	3.88	4.11	4.10	3.85	3.63	3.54
Monroe	2.06	2.40	2.67	3.15	3.51	3.50	3.78	3.87	3.76	3.43	3.30	3.12
Milwaukee	3.295	3.379	3.814	4.022	4.289	4.642	4.821	4.929	4.959	4.765	4.598	4.553
Escanaba	3.48	3.75	3.87	4.16	4.60	4.70	.....	.....	.....	4.97	4.78	4.59
Sand Beach	3.38	3.65	3.84	4.08	4.27	4.57	4.82	4.94	4.93	4.83	4.66	4.59
Marquette	2.35	2.22	2.30	2.28	2.33	2.52	2.81	3.04	3.21	3.31	2.94	2.62
Sault Ste. Marie	2.178	2.169	2.301	2.259	2.358	2.659	2.959	3.095	3.296	3.317	2.915	2.527

APPENDIX F F F.

EXPLORATIONS AND SURVEYS IN MILITARY DEPARTMENTS.

F F F 1.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF THE MISSOURI.

ANNUAL REPORT OF MAJ. WILLIAM L. MARSHALL, CORPS OF ENGINEERS, FOR THE FISCAL YEAR ENDING JUNE 30, 1895.

ENGINEER OFFICE,
HEADQUARTERS DEPARTMENT OF THE MISSOURI,
Chicago, Ill., June 30, 1895.

SIR: I have the honor to submit the following report as engineer officer of this department for the year ending June 30, 1895:

No field work has been done during the year.

The office force has consisted of one clerk, Frederick A. Petersen, who has acted as draftsman also.

The office work has consisted in the preparation of maps and drawings, tracings, reproductions, etc., for the use of the department commander and the other officers connected with these headquarters.

Made 2 tracings of "Plan and profile of a target range for Fort Brady, Mich.," First Lieut. B. M. Purssell, Nineteenth Infantry; 2 tracings of "U. S. lands proposed to be reserved for a target range for troops at Fort Brady, Mich.," near Rexford Station, on the Duluth, South Shore and Atlantic Railroad, 27 miles west of Sault Ste. Marie; 1 sketch of Sergeant O'Rourke's (Company G, Fifteenth Infantry) score in Army competition, 1893; 1 blue print of map of Fort Sill Military Reservation, Okla., Lieutenant Bailey, 1882; 1 tracing of a humorous sketch of the different arms of the Army.

Issued 8 copies of General Land Office maps to officers.

Made 1 drawing and 1 tracing of "Front view of 1,800 yards target on the Illinois National Guard range at Camp Logan, Ill., showing 89 shots fired October 27, 1894, with the Krag-Jorgensen rifle;" 1 tracing of "Map of the military reservation of Fort Wayne, Mich.," Second Lieut. T. O. Murphy, Nineteenth Infantry, January, 1895; 1 tracing of Fort Sheridan Military Reservation showing proposed telephone lines; 1 tracing of the "Reservation of the U. S. Military Prison, Fort Leavenworth, Kans.;" 1 tracing of part of the "Map of the military reservation, Fort Leavenworth," Lieutenant Ruffner, 1874, and 1 blue print of same; 1 tracing of "Jefferson Barracks Military Reservation with contours," by Lieut. H. L. Ripley, Third Cavalry, April, 1895.

Issued 8 copies of map of Indian Territory, Lieutenant Ruffner, 1875 and 1881; 12 blue prints of map of Jefferson Barracks Military Reservation with contours, Lieut. H. L. Ripley, Third Cavalry, April, 1895.

Mounted 6 maps for officers at headquarters.

Reduced to a small scale (for the use of Major-General Ruger) the plans of the military reservations in the department.

Enlarged, from the General Land Office maps of Oklahoma and Indian Territories, the country lying between 97° and 100° longitude, and between 34° and 36° 30′ north latitude, 9 sheets, with a view of having the sheets filled out and completed by officers detailed from Forts Reno and Sill.

In accordance with an order from Headquarters of the Army, April, 1894, contour maps of Forts Sill, Supply, and Wayne have been furnished the Quartermaster-General's Office, while those of Forts Leavenworth and Mackinac have not been furnished through this office.

RECAPITULATION.

Prepared 19 original drawings, 11 tracings, and 13 blue prints, mounted 6 maps and issued 16 maps.

Very respectfully, your obedient servant,

W. L. MARSHALL,
Major, Corps of Engineers, U. S. A.,
Engineer Officer, Department of the Missouri.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

FFF 2.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF CALIFORNIA.

ANNUAL REPORT OF LIEUT. JOHN L. SEHON, TWENTIETH INFANTRY, A. D. C., FOR THE FISCAL YEAR ENDING JUNE 30, 1895.

ENGINEER OFFICE,
HEADQUARTERS DEPARTMENT OF CALIFORNIA,
San Francisco, Cal., July 20, 1895.

SIR: I have the honor to submit the following report for the fiscal year ending June 30, 1895, of the official transactions of this office:

PERSONNEL.

First Lieut. John L. Sehon, Twentieth Infantry, aid-de-camp, in compliance with General Orders, No. 19, headquarters Department of the Columbia, September 14, 1894, assumed charge of the office on September 15, 1894, relieving Maj. Tully McCrea, Fifth Artillery.

Mr. Charles A. Homan, assistant to the engineer officer, has continued on duty in the office throughout the year, rendering very efficient and valuable service.

FIELD WORK

Levels to determine the difference between sea level and the datum plane of the Vancouver Barracks, Wash., contour map.

Survey of the Vancouver Barracks target range.

Survey of the southwest corner of the Vancouver Barracks reservation, to determine the location of the city wharf with reference to the respective riparian rights of the United States Government and the owners of the wharf.

Survey of certain lines on the Boise Barracks (Idaho) Military Reservation, to establish the corrected boundaries of the same, and since announced in General Orders, No. 8, headquarters Department of the Columbia, June 3, 1895.

OFFICE WORK.

Collecting and compiling geographical information for the improvement of the military maps of the department from recent Land Office surveys, official railway guides, and from the reconnaissance maps and itineraries referred to this office by the adjutant-general of the department.

Making contour maps and tracings of Forts Walla Walla, Townsend, and Spokane, Wash., from data furnished by maps prepared by officers at the posts named.

Making copy of the map and report of Capt. A. G. Forse (then first lieutenant, First Cavalry) of an examination for a wagon road from Mount Idaho to Little Salmon Meadows, Idaho.

Tracing of reconnaissance map of the region between the Mullan and Lolo trails, Idaho, by First Lieut. James A. Leyden, Fourth Infantry.

Making contour map and tracing of Fort Sherman, Idaho.

Large tracing of Puget Sound and adjacent waters, showing the military reservations and locations of the fortification sites selected by the Board of United States Engineers.

Tracing showing location of the military reservations at the Narrows of Puget Sound, transferred to the Secretary of the Interior November 14, 1894.

Tracing of contour map of Magnolia Bluff near Seattle, Wash., from survey made by the engineer of the Thirteenth light-house district.

Photographic negative of Seattle, sheet of the United States Geological Survey, and several silver prints made of the same.

Making eight large tracings (40 chains to 1 inch) of the military reservations on Washington and Puget sounds, with township and section lines.

Making skeleton map of the Department of the Columbia, showing Indian reservations with legends of Executive orders, acts of Congress, treaties, areas, etc.

Collection of information relative to the settlement of Indians upon public lands.

Making map and tracing of the Boise Barracks Military Reservation, with new boundaries as declared by General Orders, No. 8, headquarters Department of the Columbia, June 3, 1895.

Compiling 31 township plats at office of surveyor-general of Idaho.

Drawing map and tracing of part of military reservation of Fort Canby, Wash., showing buildings, roads, and the location of the reservation for the United States life-saving station, as announced by General Orders, No. 5, headquarters Department of the Columbia, April 11, 1895. Two copies of this map were furnished the adjutant-general, Department of the Columbia, to be sent to the Judge-Advocate-General of the Army and the Secretary of the Treasury.

Map of the Nez Perce Indian Reservation (4 miles to 1 inch) has been commenced and is now nearing completion.

Large map of Cœur d'Alene, Idaho, mining region (1 mile to 1 inch) has been prepared, showing exact location of all mines and concentrators in that section of the State.

Thirteen department maps have been issued, 60 solar prints of different maps made, and 162 maps mounted on muslin.

Some miscellaneous work has been done in addition to the foregoing, and numerous verbal reports to the department commander and adjutant-general of the department made at various times.

No funds have been available for the use of the office during the year, the necessary materials having been furnished by the Quartermaster's Department, and the adjutant-general of the department supplying some requisite articles of office equipment.

Very respectfully, your obedient servant,

JOHN L. SEHON,
First Lieut., Twentieth Infantry, A. D. C.,
Acting Engineer Officer.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

F F F 3.

EXPLORATIONS AND SURVEYS IN THE DEPARTMENT OF CALIFORNIA.

ANNUAL REPORT OF LIEUT. J. F. REYNOLDS LANDIS, FIRST CAVALRY, A. D. C., FOR THE FISCAL YEAR ENDING JUNE 30, 1895.

ENGINEER OFFICE,
HEADQUARTERS DEPARTMENT OF CALIFORNIA,
San Francisco, Cal., July 3, 1895.

SIR: I have the honor to submit herewith the following report of operations for the fiscal year ending June 30, 1895:

Since rendering the last report Lieut. Charles G. Lyman, Second Cavalry, A. D. C., was relieved from duty as acting engineer officer by Lieut. Col. John I. Rodgers, Second Artillery, under paragraph 1, Special Orders, No. 141, dated headquarters Department of California, November 16, 1894; in paragraph 1, General Orders, No. 15, dated headquarters Department of California, June 4, 1895, Colonel Rodgers was relieved, and by paragraph 3 of the same order I was announced as acting engineer officer and have since performed the duties of the office.

C. Winstanley, clerk, has been continuously on duty in the office as topographer and draftsman.

The office work has involved the preparation of original drawings, tracing and blue-printing maps, etc., for use at these headquarters and at the posts in the department; the mounting and distribution of maps, and the care, repair, and preservation of instruments in store.

Instruments have been furnished to the different posts for field work in collecting topographical notes.

No field work has been entered into during the year.

Very respectfully,

J. F. REYNOLDS LANDIS,
First Lieut., First Cavalry, A. D. C.,
Acting Engineer Officer.

Brig. Gen. WM. P. CRAIGHILL,
Chief of Engineers, U. S. A.

them, desiring such use shall fail to agree upon the sum or sums to be paid and upon the rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War upon a hearing of the allegations and proofs of the parties.

Aids to navigation.

SEC. 7. That said bridge herein authorized to be constructed shall be so kept and managed at all times as to afford proper means and ways for the passage of vessels, barges, or rafts, both by day and by night; and there shall be displayed on said bridge by the owners thereof, from sunset to sunrise, such lights or other signals as the Light-House Board may prescribe; and such changes shall be made from time to time in the structure of said bridge as the Secretary of War may direct, at the expense of the said company, in order the more effectually to preserve the free navigation of said river.

Lights, etc.

Commencement and completion.

SEC. 8. That this Act shall be null and void unless the construction of said bridge shall be commenced within one year and completed within three years from the passage of this Act.

Amendment, etc.

SEC. 9. That Congress shall have power at any time to alter, amend, or repeal this Act.

Approved, March 2, 1895.

March 2, 1895.

CHAP. 162.—An Act Making appropriations for fortifications and other works of defense, for the armament thereof, for the procurement of heavy ordnance for trial and service, and for other purposes.

Fortifications appropriations.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the sums of money herein provided for be, and the same are hereby appropriated out of any moneys in the Treasury not otherwise appropriated, to be available until expended, namely:

Gun and mortar batteries.

GUN AND MORTAR BATTERIES: For construction of gun and mortar batteries, four hundred thousand dollars.

For construction of gun and mortar platforms, one hundred thousand dollars.

Preservation etc.

PRESERVATION AND REPAIR OF FORTIFICATIONS: For the protection, preservation, and repair of fortifications for which there may be no special appropriation available, forty-five thousand dollars.

For preparation of plans for fortifications, five thousand dollars.

Torpedoes for harbor defense.

TORPEDOES FOR HARBOR DEFENSE: For the purchase of submarine mines and necessary appliances to operate them for closing the channels leading to our principal seaports, twenty thousand dollars.

For needful casemates, cable galleries, and so forth, to render it possible to operate submarine mines, twenty thousand dollars.

* * * * * * *

Board of Ordnance and Fortification.

BOARD OF ORDNANCE AND FORTIFICATION: To enable the board to make all needful and proper purchases, experiments, and tests to ascertain, with a view to their utilization by the Government, the most effective guns, small arms, cartridges, projectiles, fuses, explosives, torpedoes, armor plates, and other implements and engines of war,

Purchases, tests, etc.

and to purchase or cause to be manufactured, under authority of the Secretary of War, such guns, carriages, armor plates, and other war materials and articles as may, in the judgment of the board, be necessary in the proper discharge

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of the duty devolved upon it by the Act approved September twenty-second, eighteen hundred and eighty-eight; to

Civilian member.

pay the salary of the civilian member of the Board of Ord-

Vol. 26, p. 769.

nance and Fortifications provided by the Act of February twenty-fourth, eighteen hundred and ninety-one, and for the necessary traveling expenses of said member when traveling on duty as contemplated in said Act; for the pay-

Expenses.

ment of the necessary expenses of the board, including a per diem allowance to each officer detailed to serve thereon when employed on duty away from his permanent station, of two dollars and fifty cents a day; and for the test of experimental guns and carriages procured in accordance with the recommendations of the Board of Ordnance and

Proviso.

Fortifications, one hundred thousand dollars: *Provided*,

Right to use inventions.

That before any money shall be expended in the construction or test of any gun, gun carriage, ammunition, or implements under the supervision of the said board, the board shall be satisfied, after due inquiry, that the Government of the United States has a lawful right to use the inventions involved in the construction of such gun, gun carriage, ammunition, or implements, or that the construction or test is made at the request of a person either having such lawful right or authorized to convey the same to the Government.

Purchases to be of American manufacture. Exception.

That all material purchased under the foregoing provisions of this Act shall be of American manufacture, except in cases when, in the judgment of the Secretary of War, it is to the manifest interest of the United States to make purchases in limited quantities abroad, which material shall be admitted free of duty.

* * * * * * *

Approved, March 2, 1895.

March 2, 1895.

CHAP. 163.—An Act To authorize the construction of a bridge over the Tennessee River at or near Sheffield, Alabama.

Tennessee Bridge and Ferry Company may bridge Tennessee River, Sheffield, Ala.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be lawful for the Tennessee Bridge and Ferry Company, of Alabama, a corporation duly and legally incorporated under the laws of the State of Alabama, its successors or assigns, to construct and maintain a bridge over the Tennessee River at or near Sheffield, in Colbert County, Alabama. Said bridge shall be constructed to provide for

Railway, wagon, and foot bridge.

the passage of railway trains, and, at the option of the persons by whom it may be built, may be used for the passage

of wagons and vehicles of all kinds, for the transit of animals, and for foot passengers, for such reasonable rates of toll as may be approved from time to time by the Secretary of War.

Lawful structure and post route.

SEC. 2. That any bridge built under the provisions of this Act and subject to its limitations shall be a lawful structure, and shall be recognized and known as a post route, upon which also no higher charge shall be made for the transmission over the same of the mails, and troops, and the munitions of war of the United States, or passengers or freight passing over the said bridge, than the rate per mile paid for the transportation over the railroad or public highways leading to the said bridge; and it shall enjoy the rights and privileges of other post roads in the United States; and the United States shall have the right of way across said bridge and its approaches for postal-telegraph purposes, and all telegraph and telephone companies shall have equal rights and privileges in constructing and maintaining their lines across said bridge.

Postal telegraph, etc.

Drawbridge.

SEC. 3. That said bridge shall be constructed as a drawbridge of such character of construction, and having such width of draw openings and such elevation above high water, as the Secretary of War may prescribe; and the draw openings of said bridge shall be so protected and arranged that water crafts can be worked through them at any and all times; and the piers of said bridge shall be parallel with and the bridge itself at right angles to the current of the river: *Provided*, That said draw shall be opened promptly upon reasonable signals for the passage of boats; and said company or corporation shall maintain at its own expense, from sunset until sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe. No bridge shall be erected or maintained under authority of this Act which at any time substantially or materially obstructs the free navigation of said river; and if any bridge erected under such authority shall, in the opinion of the Secretary of War, obstruct such navigation he is hereby authorized to cause such change or alteration of said bridge to be made as will effectually obviate such obstruction; and all such alterations shall be made and all such obstructions be removed at the expense of the owner or owners of said bridge, and in case of any litigation arising from any obstruction or alleged obstruction to the free navigation of said river, caused or alleged to be caused by said bridge, the cause may be brought in the circuit court of the United States or the State of Alabama in whose jurisdiction any portion of said obstruction or bridge may be located: *Provided further*, That nothing in this Act shall be so construed as to repeal or modify any of the provisions of law now existing in reference to the protection of the navigation of rivers or exempt this bridge from the operation of the same.

Provisos.
Opening draw.
Lights, etc.
Free navigation.
Changes.
Existing laws.

Use by railroad companies.

SEC. 4. That all railroad companies desiring the use of said bridge shall have and be entitled to equal rights and privileges relative to the passage of railway trains over the same, and over approaches thereto, upon payment of a rea-

Compensation.

sonable compensation for such use; and in case the owner or owners of said bridge and the several railroad companies, or any of them, desiring such use shall fail to agree upon the sum or sums to be paid and upon rules and conditions to which each shall conform in using said bridge, all matters at issue between them shall be decided by the Secretary of War, upon a hearing of the allegations and proofs of the parties.

Secretary of War to approve plans, etc.

SEC. 5. That any bridge authorized to be constructed under this Act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the said company shall submit to the Secretary of War for his examination and approval a design and drawing of the bridge, and a map of location giving, for the space of one mile above and one mile below the proposed location, the topography of the banks of the river, the shore lines at high and low water, the directions and strength of currents at all stages, and soundings accurately showing the bed of the stream, and the location of any other bridge or bridges, and shall furnish such other information as may be required for a full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be built; and if any change is required by the Secretary of War in the plan of said bridge while the same is in progress of construction, or after its completion, or if the entire removal of said bridge is required by him at any time, the cost of such change or removal shall be paid by the company owning or controlling said bridge.

Changes.

Amendment, etc.

SEC. 6. That the right to alter or amend or repeal this Act is hereby expressly reserved.

Commencement and completion.

SEC. 7. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date hereof.

Approved, March 2, 1895.

March 2, 1895.

CHAP. 165.—An Act To authorize the Wisconsin and New Duluth Bridge Company to construct a bridge over the Saint Louis River, between the States of Wisconsin and Minnesota.

Wisconsin and New Duluth Bridge Company may bridge St. Louis River, Minn. and Wis.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Wisconsin and New Duluth Bridge Company, a corporation organized and existing under the laws of the State of Wisconsin, and its successors in interest be, and is hereby, authorized to construct, maintain, and operate a bridge, with the approaches thereto, over the Saint Louis River,

Location.

between the States of Minnesota and Wisconsin, at such point as the Secretary of War may determine, within the limits of section two, township forty-eight north, of range fifteen west of the fourth principal meridian, Minnesota, and of sections one and two, township forty-eight north, of range fifteen west of the fourth principal meridian, Wisconsin.

Said bridge shall be constructed to provide for the passage of cars, locomotives, and trains of railway companies, and shall have laid thereon and thereover railroad tracks for the more perfect connection of any railroads that are or may be constructed to said bridge, or the place of its location, to the end that interchange of traffic may be encouraged and interstate commerce promoted and facilitated; and the same shall be so built as to provide for or permit of the passage thereover of the cars and rolling stock of street railway companies, wagons, carriages, and vehicles of all kinds, animals, foot passengers, and travelers, under such reasonable rules and regulations as may be prescribed by the said company authorized hereby to construct the same, or its successors in interest, and for such reasonable rates of toll as may be fixed by said company, to be approved from time to time by the Secretary of War.

Railway, wagon, and foot-bridge.

Toll.

SEC. 2. That the bridge to be built under this Act shall be constructed as a pivot drawbridge, with a draw over the main channel of said river at an accessible and navigable point, to be approved by the Secretary of War, and with spans of not less than one hundred and twenty-five feet in length in the clear on each side of the central or pivot pier of the draw; and also a fixed span with a clear length of not less than two hundred feet between piers at the low-water line, to permit the passage of rafts under said bridge; and the clear height of said fixed and draw spans above low water shall be determined by the Secretary of War: *Provided*, That said draw shall be opened promptly, at reasonable signal, for the passage of boats, vessels, and other water craft, whose construction shall be such as not to admit of their passage under the draw of said bridge when closed, but in no case shall unnecessary delay occur in the opening of said draw: *And provided further*, That there shall be maintained by said corporation, at its own expense, from sunset to sunrise, such lights or other signals upon said bridge as the Light-House Board may prescribe, and there shall also be maintained, at its own expense, sheer booms, or other proper protection to safely guide rafts, boats, vessels, and water craft through said draw-spans; and the said company may do any dredging necessary for confining the flow of water to a permanent channel or to the maintenance thereof at navigable depths; and that the approaches to said bridge which cross the marshy flats adjoining the channel and which are overflowed at high water shall be upon open pile work consisting of bents not less than fifteen feet between centers measured parallel to the axes of the approaches.

Drawbridge.

Provisos.
Opening draw.

Lights, etc.

Aids to navigation.

SEC. 3. That the bridge and accessory works and improvements constructed under this Act and according to its terms and limitations shall be a lawful structure, and such bridge shall be recognized and known as a post route, upon which no higher charge shall be made for the transmission over the same of the mails, troops, and munitions of war of the United States than the rate per mile paid for their transmission over railroads and public highways leading to said bridge, and the United States shall have

Lawful structure and post route.

the right of way for postal and telegraph purposes across said bridge free of charge.

Use by railway companies.

SEC. 4. That all railroad and street railway companies desiring to use said bridge shall have and be entitled to equal rights and privileges in the passing over the same and in the use of the machinery and fixtures thereof, and

Compensation.

of the approaches thereto, for a reasonable compensation, to be paid to the owner or owners thereof; and if the owner or owners of said bridge and the several railroad and street railway companies, or any of them, desiring such use shall fail to agree upon the sum or sums to be paid and the rules or conditions to which each shall conform in using the same, all matters at issue between them shall be decided by the Secretary of War, upon a hearing of the allegations and proofs of the parties, of which hearing each party shall have due notice, and the determination of the Secretary of War thereof shall be binding upon the parties to such controversy.

Secretary of War to approve plans, etc.

SEC. 5. That in order that any bridge built under the authority of this Act may be constructed and built without any material interference with the security and convenience of the navigation of said river beyond which is necessary to carry into effect the rights and privileges hereby granted, and in order to secure compliance with the conditions herein specified, the said corporation so constructing the same shall, previous to commencing the work of construction of said bridge, submit the plans and location thereof with a detailed map of the river at the proposed site of the bridge and near thereto, exhibiting the depths and currents of such river, to the Secretary of War for his approval, together with such other information concerning said bridge and said river as may be deemed requisite by him, and until he approves the plans and location of the said bridge it shall not be built. The Secretary of War upon receiving such map and plans shall proceed with due diligence to consider the same, and being satisfied that the same conform to the prescribed conditions of this Act, shall notify said company that he approves the same,

Changes.

and shall notify said company of any changes or modifications necessary in order that the same be made to conform to said conditions, and the said company, upon receiving such notification, may proceed to erect the said bridge in conformity with the approved plans and location and the conditions herein prescribed, and no change shall be made therein without the consent of the Secretary of War and

Proviso. Notification of examining plans.

his approval thereof: *Provided, however*, That the Secretary of War shall give or cause to be given to said corporation reasonable notice of the time and place of the consideration of said plans and maps by him or by any officer of his Department, and the said corporation shall have the right to appear with its engineer and attorney, or either, before such officer and be heard on behalf of said plans before him, as well as before any officer authorized by him to report upon the same.

Litigation.

SEC. 6. That in case of any litigation arising by reason of any obstruction of the free navigation of said river by

reason of said bridge, the cause may be tried before the circuit court of the United States for the States of Minnesota or Wisconsin. And the said corporation, its successors or assigns in interest, for the purpose of acquiring necessary rights of way for the construction of necessary abutments and approaches for said bridge, and the lines and tracks of railroad thereon, shall have the power to acquire the same by purchase, gift, or conveyance, or by the exercise of the power of eminent domain, and for such latter purposes may institute proceedings in the proper court having jurisdiction in each or either of the States wherein the premises sought to be condemned are located, or in the circuit court of the United States in the proper district or division of either of said States; said proceedings to be conducted in all respects in conformity with the provisions of law in such State or States for the acquisition by condemnation of private property and appropriating the same to public use by corporations authorized to exercise the power of eminent domain.

Condemnation proceedings.

SEC. 7. That if such bridge hereby authorized to be constructed shall not be commenced within one year and finished in three years from the date of the approval of this Act the rights and privileges hereby granted shall determine and cease.

Commencement and completion.

SEC. 8. That the right to alter, amend, or repeal this Act is hereby expressly reserved.

Amendment, etc.

Approved, March 2, 1895.

CHAP. 167.—An Act To authorize the Washington and Marlboro Electric Railway Company, of Maryland, to extend its line of road into and within the District of Columbia.

March 2, 1895.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Washington and Marlboro Electric Railway Company, incorporated by an act of the general assembly of Maryland, entitled "An Act to incorporate the Washington and Marlboro Electric Railway Company," and so forth, approved on the eighth day of April, eighteen hundred and ninety, is hereby authorized to construct and lay down a street railway, with the necessary switches, turn-outs, and other mechanical devices, in the District of Columbia, and run cars thereon through and along the following routes:

District of Columbia.
Washington and Marlboro Electric Railway may lay street railway, etc.

Beginning at and on the southeasterly boundary line of the District of Columbia where the line of railway of said company within the State of Maryland shall reach the same, and running thence by Suitland road, Bowen road, and Branch avenue, or other practicable route which may be approved by the Commissioners of the District of Columbia, to connect with Pennsylvania avenue extended; thence by and with said avenue to and across the tracks of the Baltimore and Ohio Railroad on Railroad avenue; thence along Railroad avenue to Naylor road and by the same to the Anacostia River; thence across the Anacostia River by a steel or iron truss bridge resting on masonry piers built parallel to the direction of the current, with pile or other secure

Route in the county.

Bridge.

and approved foundations, and with spans not less than those of the Pennsylvania avenue bridge, and with a wide drawspan over the channel. The plans of said bridge shall

Secretary of War to approve plans, etc.

be approved in writing by the Secretary of War, and the bridge shall be built by said company over and above the tracks of the Baltimore and Potomac Railroad in such manner and at such height as not to interfere with the use of said railroad; * * * These routes may be modified or extended at the will of Congress, and the said railway company shall comply with such modifications or extensions.

* * * * * * *

Deposit to defray expenses.

SEC. 9. That the said company shall, before commencing work on said railroad on such street, deposit with the Treasurer of the United States, to the credit of the Washington Aqueduct, such sum as the Secretary of War may consider necessary to defray all the expenses that may be incurred by the United States in connection with the inspection of the work of construction of said railroad on such street, and in making good any damages done by said company or its works, or by any of its contracting agents, to any of said mains, fixtures, or apparatus, and in completing, as the Secretary of War may consider necessary, any of the work that the said company may neglect or refuse to complete, and that the Secretary of War may consider necessary for the safety of said mains, fixtures, or apparatus; and the said company shall also deposit as aforesaid such further sums for said purposes at such times as the

Provisos. Disbursement.

Secretary of War may consider necessary: *Provided*, That the said sum shall be disbursed like other moneys appropriated for the Washington Aqueduct, and that whatever shall remain of said deposits at the end of one year after the completion of said railroad in such street shall be returned to said company on the order of the Secretary of War, with an account of its disbursement in detail: *And provided also*, That disbursements of said deposits shall,

Orders.

except in cases of emergency, be made only on the order of the Secretary of War.

* * * * * * *

Commencement and completion.

SEC. 11. That the line of the said railway company shall be commenced within one year and completed within two years from the passage of this Act.

* * * * * * *

Approval of plans, etc.

SEC. 23. That all plans relating to the location and construction of said railway shall be subject to the approval of the Commissioners of the District of Columbia, or their successors, and all work shall at all times be subject to their supervision. * * *

Assigns to comply with conditions, etc.

SEC. 24. That all the conditions, requirements, and obligations imposed by the terms of this Act upon the Washington and Marlboro Electric Railway Company shall be complied with by any and all the successors to and assigns of said Company.

Amendment, etc.

SEC. 25. That this Act may at any time be altered, amended, or repealed by the Congress of the United States.

Approved, March 2, 1895.

CHAP. 168.—An Act To incorporate the Capital Railway Company. March 2, 1895.

District of Columbia.
Capital Railway Company incorporated.
Incorporators.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That John B. Stetson, Augustus Burgdorf, Clarence F. Norment, Arthur E. Randle, Harry Upson Sims, Henry C. Longnecker, W. Frederick Snyder, Joseph B. Lewis, and William Henry Randle, of , their associates and assigns, be, and they are hereby, created a body corporate under the name of the Capital Railway Company, and by that name shall have perpetual succession, and shall be able to sue and be sued, plead and be impleaded, defend and be defended in all courts of law and equity within the United States, and may make and have a common seal. And said corporation is hereby authorized to construct and lay down a street railway, with the necessary switches, turn-outs, and other mechanical devices in the District of Columbia, and run cars thereon for carrying passengers, parcels, milk, and truck by and along the following route: Beginning at a point on the District line near the Potomac River, southeast of Shepherds Ferry, thence north by such route as shall be approved by the District Commissioners to the south side of the Eastern Branch or Anacostia River, thence across the same by transfer ferry to First street or South Capitol street, as may be approved by the District Commissioners, to M street, over the same route to the beginning; also commencing at Anacostia railroad tracks and Harrison street, Anacostia; thence along Harrison street and Good Hope Road, Good Hope Road extended, to the District line, and return over same route. These routes may be modified or extended at the will of Congress, and the Capital Railway Company shall comply with such modifications or extensions.

* * * * * * *

Construction.

SEC. 8. That it shall be lawful for said railway company, its successors or assigns, having first obtained the permission of the District Commissioners therefor, to make all needful and convenient trenches and excavations in any of said streets or places where said company may have the right to construct and operate its road, and place in such trenches and excavations all needful and convenient devices and machinery for operating said railroad in the same manner and by the means herein provided, but shall forthwith restore the street to like good condition as it was before. But whenever such trenches or excavations shall interfere with any sewer, gas, or water pipes, or any subways or conduits, or any public work of the kind, then the expense necessary to change such underground constructions shall be borne by the said railroad company.

Changes of pipes, etc.

Deposit to defray inspection, etc., expenses.

SEC. 9. That the said company shall, before commencing work on said railroad on such street, deposit with the Treasurer of the United States, to the credit of the Washington Aqueduct, such sum as the Secretary of War may consider necessary to defray all the expenses that may be incurred by the United States in connection with the inspection of the work of construction of said railroad on

such street, and in making good any damages done by said company or its works, or by any of its contracting agents, to any of said mains, fixtures, or apparatus, and in completing, as the Secretary of War may consider necessary, any of the work that the said company may neglect or refuse to complete, and that the Secretary of War may consider necessary for the safety of said mains, fixtures, or apparatus; and the said company shall also deposit as aforesaid such further sums for said purposes at such times as the Secretary of War may consider necessary: *Provided*, That the said sum shall be disbursed like other moneys appropriated for the Washington Aqueduct, and that whatever shall remain of said deposits at the end of one year after the completion of said railroad in such street shall be returned to said company on the order of the Secretary of War, with an account of its disbursement in detail: *And provided also*, That disbursements of said deposits shall, except in cases of emergency, be made only on the order of the Secretary of War.

Provisos.
Disbursement.

Return of balance.

Orders.

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Commencement and completion.

SEC. 11. That the line of the said railway company shall be commenced within one year and completed within three years from date of the passage of this Act; and in default of such commencement or completion within the time in this section specified, all rights, franchises, and privileges granted by this Act shall immediately cease and determine.

* * * * * * *

Rights, etc., forfeited on failure to build.

SEC. 27. That should the Capital Railway Company fail to commence or complete the construction of its road within the limit of time prescribed by this Act, all rights, franchises, and privileges herein granted shall cease and determine.

* * * * * * *

Assigns to comply with conditions.

SEC. 29. That all the conditions, requirements, and obligations imposed by the terms of this Act upon the Capital Railway Company shall be complied with by any and all the successors to and assigns of said company.

Amendment, etc.

SEC. 30. That this Act may at any time be altered, amended, or repealed by the Congress of the United States.

Approved, March 2, 1895.

March 2, 1895.

CHAP. 170.—An Act To authorize the Pittsburg, Monongahela and Wheeling Railroad Company to construct a bridge over the Monongahela River.

Pittsburg, Monongahela and Wheeling Railroad Company may bridge Monongahela River, Monongahela City, Pa.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That it shall be lawful for the Pittsburg, Monongahela and Wheeling Railroad Company, a corporation organized under the laws of the Commonwealth of Pennsylvania, or its successors or assigns, to construct and maintain a bridge and approaches thereto across the Monongahela River at a point in the county of Allegheny, Pennsylvania, opposite, or as nearly opposite as may be, Monongahela City in said State;

that said bridge may be constructed for railway, wagon, and postal service, with single or double track for railway traffic, and shall be constructed under the conditions and limitations hereinafter specified. Railway and wagon bridge.

SEC. 2. That said bridge shall not interfere with the free navigation of said river beyond what may be necessary to carry into effect the rights and privileges herein granted, and in case of any litigation arising under the provisions of this Act such litigation may be tried and determined by the circuit court of the United States within whose jurisdiction said bridge is located. Free navigation. Litigation.

SEC. 3. That the bridge hereby authorized to be constructed must be constructed as a through bridge, with unbroken and continuous spans, the channel span over the waterway to have a clear channel of not less than five hundred feet and a clear head room of not less than fifty-three feet above the level of the water at pool full in said river, the remaining spans to be as may be approved by the Secretary of War. High bridge.

SEC. 4. That any bridge constructed under this Act shall be a lawful structure and shall be known as a post-road, over which no higher charge shall be made for the transportation of mails, troops, and munitions of war or other property of the Government of the United States, or for passengers or freight passing over the same, than the rate per mile charged for their transportation over the railways or public highways leading to said bridge. The United States shall also have the right of way over said bridge for postal telegraph purposes. Lawful structure and post route. Postal telegraph.

SEC. 5. That all railway, telephone, and telegraph companies desiring to use said bridge shall be entitled to equal rights and privileges in using the same, including machinery and fixtures thereto belonging, and also the approaches thereto, upon such terms and conditions as may be agreed upon between the Pittsburg, Monongahela, and Wheeling Railroad Company and the companies desiring to use the said bridge and approaches thereto, or, in case of a disagreement, upon such terms and conditions as shall be prescribed by the Secretary of War upon hearing the allegations and proofs of the parties in interest. Use by other companies. Terms.

SEC. 6. That the said railroad company, before entering upon the construction of said bridge, shall submit to the Secretary of War plans and drawings of said structure, together with a map of the location thereof for one mile above and one-half a mile below said location, giving the topography of the banks of the river, the shore lines at high and low water, the direction and strength of the current of said river at high and low water, showing also the bed of the river and the channel, with such other and further information as the Secretary of War may require; which said drawings and information aforesaid shall be examined by him, and if he shall approve the same he shall so notify the said railroad company of such approval, and thereupon said company may proceed to the erection of said bridge. The Secretary of War may direct such alterations in such plans as he may deem necessary to the Secretary of War to approve plans, etc. Changes.

better protection of navigation, and such alterations shall be adopted by said railroad company. The said railroad company may at any time make any alterations deemed advisable to be made in said bridge, but must first submit such proposed alterations to the Secretary of War, and his approval shall be first had before they shall be authorized or made.

Aids to navigation.

SEC. 7. That said bridge herein authorized to be constructed shall be so kept and managed at all times as to afford proper ways and means for the passage of vessels, barges, or rafts under it, both by day and by night. There shall be displayed on said bridge from sunset to sunrise

Lights, etc.

such lights and signals as may be directed by the Light-House Board, and such changes may be made from time to time in the structure of said bridge as the Secretary of War may direct, at the expense of said railroad company in order the more effectually to preserve the free navigation of said river, or the said structure shall be altogether removed, if in the judgment of the Secretary of War the public good may require such removal, and without expense or charge to the United States.

Commencement and completion.

SEC. 8. That this Act shall be null and void if actual construction of the bridge herein authorized be not commenced within one year and completed within three years from the date of the approval of this Act.

Amendment, etc.

SEC. 9. That the right to alter, amend, or repeal this Act is hereby specially reserved.

Approved, March 2, 1895.

March 2, 1895.

CHAP. 171.—An Act To authorize the construction of a bridge across the Illinois River at or near the town of Hennepin.

Illinois River Bridge Company may bridge Illinois River at Hennepin, Ill.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Illinois River Bridge Company, of Hennepin, a corporation organizing under the laws of the State of Illinois, its assigns, grantees, successors, and legal representatives, be, and are hereby, authorized to build, own, operate, and maintain a bridge and approaches thereto over the Illinois River at or near the town of Hennepin, in said State of Illinois.

Railway, wagon, and foot bridge.

Said bridge shall be constructed to provide for the passage of railway trains, and, at the option of the persons by whom it may be built, may be used for the passage of wagons and vehicles of all kinds, for the transit of animals, and for foot passengers, for such reasonable rates of toll as the owner or owners of said bridge may from time to time prescribe, subject to the approval of the Secretary of War: *Provided*,

Proviso. Use by other companies.

That all railroad companies desiring the use of said bridge and the approaches thereto shall have and be entitled to equal privileges in the use thereof upon the payment of reasonable compensation therefor, and in case of any disagreement regarding the compensation to be paid or the conditions to be observed the matters at issue shall be decided by the Secretary of War upon proper hearing.

Secretary of War to approve plans, etc.

SEC. 2. That any bridge authorized to be constructed under this Act shall be built and located under and subject to such regulations for the security of navigation of said river as the Secretary of War shall prescribe; and to secure that object the company or corporation shall submit to the Secretary of War for his examination and approval a design and drawing of the bridge and a map of the location, giving, for the space of one mile above and below the proposed location, the topography of the banks of the river, the shore lines at low and high water, the direction and current strength at all stages, and the soundings, accurately showing the bed of the stream, and shall furnish such other information as shall be required for the full and satisfactory understanding of the subject; and until the said plan and location of the bridge are approved by the Secretary of War the bridge shall not be built; and should any change be made in the plan of said bridge during the progress of construction, such change shall be subject to approval of the Secretary of War; and if said bridge is not commenced within one year and completed within three years from the passage of this Act the rights and privileges hereby granted shall be null and void.

Changes.

Commencement and completion.

Lawful structure and post route.

SEC. 3. That any bridge constructed under this Act and according to its limitations shall be a lawful structure and shall be recognized and known as a post route, upon which, also, no higher charge shall be made for the transmission over the same of the mails, the troops, and the munitions of war of the United States than the rates established and paid by the general public for like service; and the United States shall have the right of way for postal telegraph and telephone purposes across said bridge. That in case of any litigation concerning any alleged obstruction to the free navigation of said river on account of said bridge, the cause may be tried before the circuit court of the United States in whose jurisdiction said obstruction or bridge is located. That if the said bridge shall be constructed as a draw-bridge the draw shall be opened promptly, upon reasonable signal, for the passage of boats, and whatever kind of bridge is constructed the said company or corporation shall maintain, at its own expense, from sunset to sunrise, such lights or other signals on said bridge as the Light-House Board shall prescribe.

Postal telegraph.

Litigation.

Opening draw.

Lights, et

Amendment, etc.

SEC. 4. That the right to alter, amend, or repeal this Act is hereby expressly reserved, and the right to require any change in the structure, or its entire removal, at the expense of the owners thereof, whenever Congress decides that the public interest requires it, is also expressly reserved.

Approved, March 2, 1895.

March 2, 1895.

CHAP. 176.—An Act Making appropriations to provide for the expenses of the government of the District of Columbia for the fiscal year ending June thirtieth, eighteen hundred and ninety-six, and for other purposes.

District of Columbia appropriations.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the half of the following sums named, respectively, is hereby

appropriated, out of any money in the Treasury not otherwise appropriated, and the other half out of the revenues of the District of Columbia, for the purposes following, being for the expenses of the government of the District of Columbia for the fiscal year ending June thirtieth, eighteen hundred and ninety-six, namely.

Half from District revenues.

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Bridge across Eastern Branch from South Capitol street.

BRIDGE ACROSS THE EASTERN BRANCH: To enable the Secretary of War to make a survey, plan, and estimate of the cost of the construction of a substantial and suitable bridge, with necessary approaches, from the foot of South Capitol street, or below it at the most available point, across the Eastern Branch of the Potomac River, in the District of Columbia, and to report thereon to the Congress of the United States with such recommendations as he may deem proper, three thousand five hundred dollars.

Aqueduct.

WASHINGTON AQUEDUCT.

Engineering.

For engineering, maintenance, and general repairs, twenty thousand dollars.

Receiving reservoir.

For completing the improvement of the Dalecarlia receiving reservoir by the works required for cutting off the drainage into it of polluted water and sewage from the surrounding country; for completing the purchase or condemnation of the small amount of land required for the purpose, and the excavation necessary at the head of the reservoir, thirty-seven thousand five hundred dollars, the same to be immediately available said work to be done and completed under the supervision of Colonel George H. Elliott, Corps of Engineers, notwithstanding his retirement, and said officer shall be allowed until such completion the pay and allowances of officers of his grade on the active list, and in case of the death or disability of such officer the work shall be completed under the direction and charge of the Chief of Engineers.

Col. George H. Elliott to remain in charge of work, pay, etc.

Cleaning conduit.

For removing the accumulation of deposits in the conduit, fourteen thousand dollars, to be immediately available.

Dam at Great Falls. Raising height, etc.

For raising the height of the dam at Great Falls, together with the cost of such other work as may be found necessary in connection therewith, including the cost of strengthening the conduit, and for damages on account of flooding of land and other damages, one hundred and twenty-five thousand dollars, for which amount and purposes the available balance of the appropriation for increasing the water supply of the city of Washington shall be applicable, subject to all the provisions and restrictions of the Act to increase the water supply of the city of Washington, and for other purposes, approved July fifteenth, eighteen hundred and eighty-two, and of the Act approved July fifth, eighteen hundred and eighty-four, making appropriations for the expenses of the government of the District of Columbia, as to apportionment and settlement between the United States and the District of Columbia,

Vol. 22, p. 168.

Vol. 24, p. 132.

and the refunding thereof. And in the execution of this work, General Thomas L. Casey shall be associated with the proper officer in charge of the Washington Aqueduct as consulting engineer.

Gen. Thomas L. Casey, consulting engineer.

For testing the tunnel conduit to determine the amount of its leakage, twenty-five thousand dollars, to be taken from the appropriation "for increasing the water supply of Washington, District of Columbia," to be immediately available.

Tunnel conduit to be tested.

There shall be prepared, upon careful investigation by the proper officer of the Government having the charge of the Washington Aqueduct and the water supply to the city of Washington, a full and detailed report, which shall be submitted to Congress on the first Monday in December, eighteen hundred and ninety-five, upon the feasibility and propriety of completing the tunnel conduit as now projected; the completion of the new reservoir, including its dam or any modifications to the same deemed necessary; and upon the results as to the supply of water to the city when said dam, the raising of the dam at the Great Falls, the conduit, and reservoir are completed. And if such officer and consulting engineer shall conclude that it is impracticable, or too expensive, to repair such tunnel conduit, then they shall report some plan for bringing increased water supply from the reservoir in Georgetown to Washington by pipes or otherwise.

Report on completing conduit, reservoir, etc.

Each separate item of the report shall be accompanied by a detailed estimate of the cost of the work required and the necessary costs, not to exceed ten thousand dollars, connected with the inquiry and reports, shall be defrayed from the appropriation for "increasing the water supply of Washington, District of Columbia:" *Provided*, That in the preparation of this report General Thomas L. Casey, United States Army, shall be associated with the proper officer of the Government in charge of the aqueduct as consulting engineer, and his signature shall be appended to said report in said capacity, and said report shall also be accompanied with the judgment of the Chief of Engineers, and made to the Secretary of War, who shall transmit the same to Congress with his views thereon.

Detailed estimates.

Proviso. Report.

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Approved, March 2, 1895.

CHAP. 177.—An Act Making appropriations for the legislative, executive, and judicial expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety-six, and for other purposes.

March 2, 1895.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, out of any money in the Treasury not otherwise appropriated, in full compensation for the service of the fiscal year ending June thirtieth, eighteen hundred and ninety-six, for the objects hereinafter expressed, namely:

Legislative, executive, and judicial expenses appropriations.

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War Department.

WAR DEPARTMENT.

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Engineer office. OFFICE OF THE CHIEF OF ENGINEERS: Chief clerk, two thousand dollars; four clerks of class four; two clerks of class three; three clerks of class two; three clerks of class one; one clerk, one thousand dollars; one assistant messenger; and two laborers; in all, twenty-three thousand two hundred and forty dollars.

Draftsmen, etc. And the services of skilled draftsmen, civil engineers, and such other services as the Secretary of War may deem necessary, may be employed only in the office of the Chief of Engineers to carry into effect the various appropriations for rivers and harbors, fortifications, and surveys to be paid from such appropriations: *Provided*, That the expenditures on this account for the fiscal year ending June thirtieth, eighteen hundred and ninety-six, shall not exceed seventy-two thousand dollars; and that the Secretary of War shall each year, in the annual estimates, report to Congress the number of persons so employed and the amount paid to each.

Proviso. Limit, etc.

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Public buildings and grounds.

PUBLIC BUILDINGS AND GROUNDS.

Clerk, messenger, etc. OFFICE OF PUBLIC BUILDINGS AND GROUNDS: For one clerk, one thousand six hundred dollars; one messenger; one public gardener, one thousand eight hundred dollars; in all, four thousand two hundred and forty dollars.

Overseers, etc. For overseers, draftsmen, foremen, mechanics, gardeners, and laborers employed in the public grounds, twenty-eight thousand dollars.

Watchmen. For day watchman in Franklin Square, six hundred and sixty dollars.

For day watchman in Lafayette Square, six hundred and sixty dollars.

For two day watchmen in Smithsonian Grounds, at six hundred and sixty dollars each, one thousand three hundred and twenty dollars.

For two night watchmen in Smithsonian Grounds, at seven hundred and twenty dollars each, one thousand four hundred and forty dollars.

For one day watchman at Judiciary Square and one at Lincoln Square and adjacent reservations, at six hundred and sixty dollars each, one thousand three hundred and twenty dollars.

For one night watchman at Judiciary Square, seven hundred and twenty dollars.

For one day watchman at Iowa Circle; one at Thomas Circle and neighboring reservations; one at Washington Circle and neighboring reservations; one at Dupont Circle and neighboring reservations; one at McPherson and Farragut squares; one at Stanton Square and neighboring reservations; two at Henry and Seaton squares and reser-

vations east of Botanic Garden; one at Mount Vernon Square and adjacent reservations; one for the greenhouses and nursery; one at grounds south of Executive Mansion; eleven in all, at six hundred and sixty dollars each, seven thousand two hundred and sixty dollars.

For one night watchman at Henry and Seaton squares and reservations east of Botanic Garden, seven hundred and twenty dollars.

For one night watchman at Garfield Park, seven hundred and twenty dollars.

For contingent and incidental expenses, five hundred dollars. Contingent expenses.

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Approved, March 2, 1895.

CHAP. 178.—An Act For the removal of snow and ice from the sidewalks, crosswalks, and gutters in the cities of Washington and Georgetown, and for other purposes. March 2, 1895.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

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SEC. 5. That it shall be the duty of the superintendent of public buildings and grounds in the District of Columbia, immediately after a fall of snow or sleet, or as soon thereafter as practicable, to engage such assistance as he may deem necessary, when funds are available, and proceed to remove from all paved sidewalks or crosswalks which may be used as thoroughfares around, about, or through the public parks within the cities of Washington and Georgetown all accumulations of snow or sleet to a width sufficient to accommodate winter pedestrian travel; or in case the same be so congealed as to make removal by ordinary methods impossible, he shall cause such paved side or crosswalks to be liberally sprinkled with sand or sawdust or such other material as will insure safety to pedestrians who, in the lawful and legitimate pursuit of their respective avocations, find it convenient to pass around, about, or through said public parks. And it shall be the duty of the superintendent of public buildings and grounds, personally, or by deputy or deputies, to visit each public park in the cities of Washington and Georgetown as soon as possible after any snow or sleet storm, as aforesaid, and carefully inspect the work as herein provided for.

Removal of snow, etc., from sidewalks, etc., public parks.

Ice, etc., to be sprinkled with sand, etc.

Inspection.

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Approved, March 2, 1895.

CHAP. 187.—An Act Making appropriations to supply deficiencies in the appropriations for the fiscal year ending June thirtieth, eighteen hundred and ninety-five, and for prior years, and for other purposes. March 2, 1895.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropri-

Deficiencies appropriations.

ated, out of any money in the Treasury not otherwise appropriated, to supply deficiencies in the appropriations for the fiscal year eighteen hundred and ninety-five, and for prior years, and for other objects hereinafter stated, namely:

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War Department.

WAR DEPARTMENT.

Indian River Inlet.

That in addition to the amount heretofore appropriated the sum of fifteen thousand dollars shall be, and the same is hereby, appropriated, out of any money in the Treasury not otherwise appropriated, for dredging the channel at the Indian River Inlet, the same to be expended under the direction of the Secretary of War.

Dredging channel.

Laws, 2d sess. 53d Cong., p. 351.

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Removing snow, etc.

IMPROVEMENT AND CARE OF PUBLIC GROUNDS: For removing snow and ice, five hundred dollars.

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Approved, March 2, 1895.

March 2, 1895.

CHAP. 189.—An Act Making appropriations for sundry civil expenses of the Government for the fiscal year ending June thirtieth, eighteen hundred and ninety-six, and for other purposes.

Sundry civil expenses appropriations.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the following sums be, and the same are hereby, appropriated, for the objects hereinafter expressed, for the fiscal year ending June thirtieth, eighteen hundred and ninety-six, namely:

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War Department.

UNDER THE WAR DEPARTMENT.

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Buildings and grounds, D. C.

BUILDINGS AND GROUNDS IN AND AROUND WASHINGTON.

Improvement and care.

For the improvement and care of public grounds as follows:

Children's playground.

For improvement of grounds north and south of Executive Mansion, five thousand dollars; and the officer in charge of public buildings and grounds shall authorize the use of a portion of the ground within the circle south of the Executive Mansion for a children's playground, under regulations to be prescribed by him.

For ordinary care of greenhouses and nursery, two thousand dollars.

For ordinary care of Lafayette Square, one thousand dollars.

For ordinary care of Franklin Square, one thousand dollars.

For ordinary care of Lincoln Square, one thousand dollars.

For care and improvement of Monument grounds, three thousand dollars.

For continuing improvement of reservation numbered seventeen and site of old canal northwest of same, three thousand dollars: *Provided*, That no part thereof shall be expended upon other than property belonging to the United States.

Old canal, etc.

Proviso. Expenditure.

For repair of post-and-chain fences and high iron fences, and constructing stone coping about reservations, one thousand five hundred dollars.

For manure, and hauling the same, four thousand dollars.

For painting watchmen's lodges, iron fences, vases, lamps, and lamp-posts, one thousand dollars.

For purchase and repair of seats, one thousand dollars.

For purchase and repair of tools, two thousand dollars.

For trees, tree and plant stakes, labels, lime, whitewashing, and stock for nursery, to be purchased by contract or otherwise, as the Secretary of War may determine, two thousand dollars.

For removing snow and ice, one thousand two hundred dollars.

For flowerpots, twine, baskets, wire, splints, moss, and lycopodium, one thousand dollars.

For care, construction, and repair of fountains, one thousand five hundred dollars.

For abating nuisances, five hundred dollars.

For improvement, care, and maintenance of various reservations, ten thousand dollars.

For improvement, maintenance, and care of Smithsonian grounds, two thousand five hundred dollars.

For improvement, care, and maintenance of Judiciary Square, two thousand five hundred dollars.

That under appropriations herein contained no contract shall be made for making or repairing concrete or asphalt pavements in Washington City at a higher price than two dollars and twenty-five cents per square yard for a quality equal to the best laid in the District of Columbia prior to July first, eighteen hundred and eighty-six, and with a base of not less than six inches in thickness.

Limit for concrete pavements.

For laying asphalt walks in various reservations, two thousand five hundred dollars.

For cleaning statues and repairing pedestals, two hundred dollars.

For expenses, including advertising, of sale of old condemned and useless property, one hundred dollars.

For repairs and fuel at the Executive Mansion, as follows:

Executive Mansion. Repairs, fuel, etc.

For care, repair, and refurnishing the Executive Mansion, twenty-five thousand dollars, to be expended by contract or otherwise, as the President may determine.

For fuel for the Executive Mansion, greenhouses, and stable, three thousand dollars.

For care and necessary repair of greenhouses, four thousand dollars.

For repairs to conservatory, Executive Mansion, two thousand dollars.

Lighting Executive Mansion and public grounds.

LIGHTING THE EXECUTIVE MANSION AND PUBLIC GROUNDS: For gas, pay of lamp-lighters, gas-fitters, and laborers; purchase, erection, and repair of lamps and lamp-posts; purchase of matches, and for repairs of all kinds; fuel, and lights for office, office stable, watchmen's lodges, and for the greenhouses at the nursery, fourteen thousand dollars: *Provided*, That for each six-foot burner not connected with a meter in the lamps on the public grounds no more than twenty dollars and fifty cents shall be paid per lamp for gas, including lighting, cleaning, and keeping in repair the lamps, under any expenditure provided for in this Act; and said lamps shall burn not less than three thousand hours per annum; and authority is hereby given to substitute other illuminating material for the same or less price, and to use so much of the sum hereby appropriated as may be necessary for that purpose: *Provided*, That before any expenditures are made from the appropriations herein provided for, the contracting gas company shall equip each lamp with a self-regulating burner and tip, so combined and adjusted as to secure under all ordinary variations of pressure and density a consumption of six cubic feet of gas per hour.

Provisos.
Maximum per lamp.

Governors.

Electric lights.

For electric lights for three hundred and sixty-five nights from seven posts, at thirty cents per light per night, seven hundred and sixty-six dollars and fifty cents.

Repair of water pipes, etc.

REPAIR OF WATER PIPES: For repairing and extending water pipes, purchase of apparatus for cleaning them, purchase of hose, and for cleaning the springs and repairing and renewing the pipes of the same that supply the Capitol, the Executive Mansion, and the building for the State, War, and Navy Departments, two thousand five hundred dollars.

For changing route of pipe line that supplies the Capitol, incasing a portion of it in concrete, and uncovering and examining the entire line, ten thousand dollars.

Telegraph, Capitol, Departments, and Printing Office.

TELEGRAPH TO CONNECT THE CAPITOL WITH THE DEPARTMENTS AND GOVERNMENT PRINTING OFFICE: For care and repair of existing lines, one thousand two hundred and fifty dollars.

Washington Monument.

WASHINGTON MONUMENT: For the care and maintenance of the Washington Monument, namely: For one custodian, at one hundred dollars per month; one steam engineer, at eighty dollars per month; one assistant steam engineer, at sixty dollars per month; one fireman, at fifty dollars per month; one assistant fireman, at forty-five dollars per month; one conductor of elevator car, at seventy-five dollars per month; one attendant on floor, at sixty dollars per month; one attendant on top floor, at sixty dollars per month; three night and day watchmen, at sixty dollars per month each; in all, eight thousand five hundred and twenty dollars.

Expenses.

For fuel, lights, oil, waste, packing, tools, matches, paints, brushes, brooms, lanterns, rope, nails, screws, lead, electric lights, heating apparatus, oil stoves for elevator car and upper and lower floors, repairs to engines, boilers, dynamos, elevator, and repairs of all kinds connected with the mon-

ument and machinery, and purchase of all necessary articles for keeping the monument, machinery, elevator, and electric-light plant in good order, three thousand dollars.

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ENGINEER DEPARTMENT. Engineer Department.

For continuing improvement of harbor at Philadelphia, Pennsylvania: Continuing improvement, removal of Smiths Island and Windmill Island, Pennsylvania, and Petty Island, New Jersey, and adjacent shoals, eight hundred and fifty thousand dollars. River and harbor improvements. Philadelphia, Pa.

For construction of movable dam numbered six, in the Ohio River, near Beaver River, in addition to the amount heretofore appropriated, the sum of one hundred and fifty thousand dollars. Ohio River, dam. Laws, 2d sess. 53d Cong., p. 355.

For improving harbor at Galveston, Texas: Continuing improvement, one million one hundred and sixty thousand dollars, one hundred thousand dollars of which may be expended for dredging, under the direction of the Secretary of War, by contract or otherwise, as may be most economical and advantageous to the United States. Galveston, Tex.

For improving Hudson River, New York: Continuing improvement, five hundred thousand dollars. Hudson River, N. Y.

For improving Great Kanawha River, West Virginia: Completing improvement, five hundred and eighty thousand seven hundred dollars. Great Kanawha River, W. Va.

That the Secretary of War be, and he is hereby, authorized, in his distribution, to apply so much of the funds now applicable to the care, preservation, and maintenance of the public works of the United States, as may be necessary, not exceeding two thousand five hundred dollars, to rebuild or repair the protection wall now standing upon the ground owned by the United States at Zanesville, Ohio, on the Muskingum River, and which is a part of the public works of said river, more particularly described as follows: Being stone wall on the west bank of the river, constructed by the State of Ohio as part of the public works of Ohio, and being that part of the wall about one hundred feet north of the Main Street bridge. Muskingum River, Ohio. Repair of wall, Zanesville.

For improving Mississippi River from the mouth of the Ohio River to the landing on the west bank below the Washington avenue bridge, Minneapolis, Minnesota: Continuing improvement from the mouth of the Ohio River to the mouth of the Missouri River, seven hundred and fifty-eight thousand three hundred and thirty-three dollars and thirty-three cents: *Provided*, That in the discretion of the Secretary of War, not exceeding one hundred and fifty thousand dollars of this appropriation may be expended in using movable jetties or steel caissons in removing bars and improving the low-water channel of said river; Continuing improvement from the mouth of Missouri River to Minneapolis, eight hundred and sixty-six thousand six hundred and sixty-six dollars and sixty-seven cents: *Provided*, That eighty-five thousand five hundred dollars thereof, or as much as may be necessary, shall be expended, under the Mississippi River, mouth of Ohio to Minneapolis. *Provisos.* Movable jetties. Warsaw to Quincy.

direction of the Secretary of War, with a view to improving the navigation from the city of Warsaw to the city of Quincy, by preventing the water from overflowing the natural and artifical banks along the east bank of that part of said river, and deepening the channel, in accordance with the survey reported on December thirteenth, eighteen hundred and ninety-four, and the accompanying estimates; and also eighty-five thousand dollars thereof shall be expended to commence the work, under the direction of the Secretary of War, from the mouth of Flint Creek, in Des Moines County, State of Iowa, and running along the west bank of the river to the mouth of the Iowa River, with a view to improving the navigation by preventing the water from overflowing the natural and artificial banks along that part of the river, and deepening the channel, in accordance with the survey reported on January third, eighteen hundred and ninety-five, and the accompanying estimates; and so much thereof as may be necessary, not to exceed one thousand dollars, may, in the discretion of the Secretary of War, be expended in the improvement of the channel to the harbor of Bay City, Wisconsin, at the head of Lake Pepin; in all, one million six hundred and twenty-five thousand dollars.

Iowa bank.

Bay City, Wis.

Saint Marys Falls, Mich. For improving Saint Marys River at the Falls, Michigan: Completing improvement, four hundred and eighty-three thousand eight hundred and sixty-five dollars.

Great Lakes. For improving channel connecting the waters of the Great Lakes between Chicago, Duluth, and Buffalo, five hundred thousand dollars.

Point Judith, harbor of refuge. For harbor of refuge at Point Judith, Rhode Island: Continuing improvement, three hundred thousand dollars.

Charleston, S. C. For improving harbor at Charleston, South Carolina: Completing improvement, five hundred thousand dollars.

Savannah, Ga. For improving harbor at Savannah, Georgia: Completing improvement, eight hundred and fifty-six thousand two hundred and fifty dollars.

Mobile, Ala. For improving harbor at Mobile, Alabama: Completing improvement, two hundred and ninety-one thousand three hundred dollars.

Humboldt, Cal. For improving harbor and bay at Humboldt, California: Continuing improvement, two hundred and twenty-five thousand dollars.

Mississippi River Commission. Under Mississippi River Commission: For improving Mississippi River from Head of the Passes to the mouth of the Ohio River, including salaries, clerical, office, traveling, and miscellaneous expenses of the Mississippi River Commission, two million six hundred and sixty-five thousand dollars.

Missouri River Commission. Under Missouri River Commission: For improving Missouri River from its mouth to Sioux City, Iowa, including salaries, clerical, office, traveling, and miscellaneous expenses of the Missouri River Commission, surveys, permanent bench marks and gauges, seven hundred and fifty thousand dollars: *Provided*, That forty thousand dollars thereof shall be expended, under the direction of the Secretary of War, for the extension of the improvements for the

Missouri River.

Proviso.

protection of the banks of the Missouri River in front of Sioux City and on the Iowa side of the river.

Sioux City, Iowa.

That the Secretary of War be, and he is hereby, authorized and directed to expend, from the appropriation of twenty-five thousand dollars "For dredging Salmon Bay, and improvement of the waterway connecting the waters of Puget Sound, at Salmon Bay, with lakes Union and Washington, by enlarging the said waterway into a ship canal, with the necessary locks and appliances in connection therewith," made by the "Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes," received by the President August seventh, eighteen hundred and ninety-four, the sum of five thousand dollars in making a definite survey and location of said improvement, and in preparing a cadastral map, showing each piece of property required to be deeded to the United States or from which a release is required, with its metes and bounds.

Ship canal, Puget Sound to lakes Union and Washington.
Laws, 2d sess. 53d Cong., p. 360.

That the President of the United States is hereby authorized to appoint a board, to consist of three officers of the Engineer Corps, who shall make an examination of the bar of the Yaquina Bay, in Oregon, with a view to a project for deeper water, and shall report the result of such investigation, with estimate of cost, to the next regular session of Congress: *Provided*, That the cost of said investigation, and also surveys and expenses of said board, shall be defrayed from the balance of money available of the appropriation made for improving the harbor at Yaquina Bay, in Oregon, by Act of Congress of August seventh, eighteen hundred and ninety-four.

Yaquina Bay, Oreg.
Examination of bar.
Laws, 2d sess. 53d Cong., p. 346.
Proviso.
Balance.

That the Secretary of War, in his discretion, is hereby directed to use and expend in dredging and deepening the channel of the Sabine River in Texas, at and across the bar at the mouth of said river in Sabine Lake, a sum not exceeding four thousand dollars, to be taken from an appropriation made at the second session of the Fifty-third Congress of the United States, amounting to two hundred and seventy-five thousand dollars, for "Improving harbor at Sabine Pass, Texas: Continuing improvement," by the Act entitled "An Act making appropriations for the construction, repair, and preservation of certain public works on rivers and harbors, and for other purposes."

Sabine River, Tex.
Dredging the bar.
Laws, 2d sess. 53d Cong., p. 343.

HARBOR OF REFUGE AT WOODS HOLL, MASSACHUSETTS: For repair of the stone pier or breakwater constituting a harbor of refuge at Woods Holl, damaged by the storm of January twenty-sixth, eighteen hundred and ninety-five, and for repairing, so far as may be necessary the wooden wharf upon said breakwater, five thousand dollars.

Woods Holl, Mass.
Harbor of refuge.

That the Secretary of War in his discretion is hereby authorized and directed, to expend, from the appropriation of thirty-seven thousand dollars for the improvement of the harbor at Oswego, New York, made by the river and harbor appropriation Act passed at the second session of the Fifty-third Congress, not to exceed eight hundred dollars for the purpose of making a survey, examination, and

Oswego, N. Y.
Laws, 2d sess. 53d Cong., p. 340.

Breakwater.

preparation of the project for the construction of an east breakwater or jetty at the mouth of the Oswego River, for the protection of the harbor and to render entrance to it easy and safe.

Dunkirk, N.Y.
Laws, 2d sess. 53d Cong., p. 340.

That the Secretary of War, in his discretion, be, and he hereby is, authorized to use a sum not exceeding eight hundred dollars of the appropriations for the improvement of the harbor at Dunkirk, New York, carried in the last river and harbor Act, for a survey of said harbor, in accordance with the recommendations of the Secretary of War.

Survey.

Nicaragua Canal.
Ascertaining feasibility, etc.

For the purpose of ascertaining the feasibility, permanence, and cost of the construction and completion of Nicaragua Canal by the route contemplated and provided for by an Act which passed the Senate January twenty-eighth, eighteen hundred and ninety-five, entitled "An Act to amend the Act entitled 'An Act to incorporate the Maritime Canal Company of Nicaragua,' approved February twentieth, eighteen hundred and eighty-nine," twenty thousand dollars, to be expended under the direction of the Secretary of State.

Vol. 25, p. 673.

Board of engineers to examine.

And a board of three engineers is hereby constituted to make the survey and examination necessary for such ascertainment; said board to be selected and appointed by the President of the United States, one from the Corps of Engineers of the United States Army, one from the Engineers of the Navy, and one from civil life; and the compensation of the members of said board shall be fixed by the President, not to exceed five thousand dollars each, including such pay as the engineers so selected are receiving, for the time they are so employed, from the Government.

Selection.

Compensation.

Duties.

And the said board, under such arrangements and regulations as shall be made by the Secretary of State with the approval of the President of the United States, shall visit and personally inspect the route of the said canal, examine and consider the plans, profiles, sections, prisms, and specifications for its various parts, and report thereon to the President; and should they ascertain that any deviation from the general line of the proposed route is desirable, they shall so state in their findings and conclusions with regard thereto in their report.

Report.

And said board shall make their report on or before November first, eighteen hundred and ninety-five; and the appropriation shall be immediately available.

The foregoing appropriations for work on rivers and harbors shall be immediately available.

* * * * * * *

Miscellaneous.

MISCELLANEOUS OBJECTS.

Survey of Northern, etc., lakes.

SURVEY OF NORTHERN AND NORTHWESTERN LAKES: For printing and issuing charts for use of navigators and electrotyping plates for chart printing, two thousand dollars.

For surveys, additions to, and correcting engraved plates, to be available until expended, twenty-five thousand dollars.

Inquiry on feasibility of deep-water channel, Great Lakes to the Atlantic.

The President of the United States is authorized to appoint, immediately after the passage of this Act, three persons, who shall have power to meet and confer with any similar committee which may be appointed by the Government of Great Britain or of the Dominion of Canada, and who shall make inquiry and report whether it is feasible to build such canals as shall enable vessels engaged in ocean commerce to pass to and fro between the Great Lakes and the Atlantic Ocean, with an adequate and controllable supply of water for continual use; where such canals can be most conveniently located, the probable cost of the same, with estimates in detail; and if any part of the same should be built in the territory of Canada, what regulations or treaty arrangements will be necessary between the United States and Great Britain to preserve the free use of such canal to the people of this country at all times; and all necessary facts and considerations relating to the construction and future use of deep-water channels between the Great Lakes and the Atlantic Ocean. The persons so appointed shall serve without compensation in any form, but they shall be paid their actual traveling and other necessary expenses, not exceeding in all ten thousand dollars, for which purpose the said sum of ten thousand dollars, or so much thereof as may be necessary, is hereby appropriated.

Expenses.

Detail.

The President may, in his discretion, detail as one of such persons an officer of the Army or Navy.

Transporting maps.

TRANSPORTATION OF REPORTS AND MAPS TO FOREIGN COUNTRIES: For the transportation of reports and maps to foreign countries through the Smithsonian Institution, one hundred dollars.

* * * * * * *

New York Harbor.

HARBOR OF NEW YORK: For prevention of obstructive and injurious deposits within the harbor and adjacent waters of New York City:

Inspectors, etc.

For pay of inspectors and deputy inspectors, office force, and expenses of office, fifteen thousand dollars;

Vessels.

For pay of crew and maintenance of steamer Argus, eight thousand dollars;

For pay of crew and maintenance of steamer Nimrod, ten thousand dollars;

For pay of crew and maintenance of one steam tug heretofore authorized by law, twelve thousand dollars, to be immediately available;

New tug.

For purchase or construction of one steam tug, forty-five thousand dollars, or so much thereof as may be necessary, to be immediately available;

In all, ninety thousand dollars.

* * * * * * *

PUBLIC PRINTING AND BINDING.

Public printing and binding.

* * * * * * *

Government Printing Office. Construction of building on adjoining lot.

GOVERNMENT PRINTING-OFFICE BUILDING: For the construction by the Chief of Engineers of a fireproof building upon the lot belonging to the United States now occupied by the stables of the Government Printing Office,

according to the plan and specifications of Colonel John M. Wilson, of the Engineer Corps, submitted to General Thomas L. Casey, Chief of Engineers, December seventeenth, eighteen hundred and ninety-four, and approved by him, one hundred and twenty-one thousand one hundred and twenty-one dollars and ninety cents, to be immediately available and until the completion of said work.

Appropriation for fire escapes, etc., continued.

The appropriation of seventy-five thousand dollars made by the sundry civil appropriation Act, approved August eighteenth, eighteen hundred and ninety-four, for the repair of the Government Printing Office, to provide fire escapes, and to put the building in a safe and secure condition, shall be available until the completion of the work.

Committee on Printing of either House to serve when no joint committee exists.

At any time when there is no joint committee of the two Houses of Congress the powers and duties under the law devolving upon the Joint Committee on Printing shall be exercised and performed by the Committee then in existence of either House.

* * * * * * *

Approved, March 2, 1895.

RESOLUTIONS.

December 24, 1894.

[No. 2.] Joint Resolution Extending time for Report of Board of Engineers surveying canal routes from Lake Erie to the Ohio River.

Ohio canals. Time extended for report of board of engineers.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Board of Engineers of the Army appointed to survey sundry canal routes through the State of Ohio under the provisions of the River and Harbor Appropriation Bill passed at the last session of the present Congress are granted an extension of time for their survey and are hereby authorized to report at the first session of the next Congress, instead of at the present session.

Laws, 2d sess. 53d Cong., p. 355.

Approved, December 24, 1894.

February 1, 1895.

[No. 8.] Joint Resolution To provide for the expenditure of the appropriation heretofore made for the dredging of Everett Harbor.

Everett Harbor, Wash. Plan for improvement adopted.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the appropriation of ten thousand dollars heretofore made for dredging Everett Harbor, at Everett, in the State of Washington, may be used by the Secretary of War in the construction of a fresh-water harbor at Everett, in said State, in accordance with the project submitted by Captain Thomas W. Symons, of Corps of Engineers, United States Army, on July ninth, eighteen hundred and ninety-four, and printed in Senate Executive Document numbered one hundred and thirty-nine, part two, second session of the Fifty-third Congress.

Laws, 2d sess. 53d Cong., p. 360.

Approved, February 1, 1895.

[No. 11.] Joint Resolution Authorizing the Secretary of War to make a survey of Kalamazoo River from Lake Michigan to Saugatuck. February 13, 1895.

Kalamazoo River, Mich. Survey ordered.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and is hereby, authorized and directed to make a survey of Kalamazoo River from Lake Michigan to Saugatuck, as contemplated in Executive Document numbered one hundred and ninety-nine, House of Representatives, Fifty-third Congress, third session, to be paid for out of appropriation heretofore made for surveys.

Approved, February 13, 1895.

[No. 15.] Joint Resolution Authorizing the Secretary of War to expend a portion of the appropriation made in the River and Harbor Act of eighteen hundred and ninety-four for Saint Joseph Harbor, in the State of Michigan, to complete the connection between Saint Joseph Harbor and Benton Harbor. February 18, 1895.

Saint Joseph, Mich. Use of appropriation for harbor. Laws, 2d sess. 53d Cong., p. 344.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and he is, authorized in his discretion to apply so much of the appropriation for the improvement of Saint Joseph Harbor, in the State of Michigan, made in the River and Harbor act of eighteen hundred and ninety-four, as may in his judgment be necessary to complete the connection between Saint Joseph Harbor and Benton Harbor in said State of Michigan.

Approved, February 18, 1895.

[No. 24.] Joint Resolution Granting permission for the erection of a bronze statue in Washington, District of Columbia, in honor of the late Professor Samuel D. Gross, doctor of medicine, doctor of laws, doctor of civil law. March 2, 1895.

Preamble.

Whereas the physicians and surgeons of the United States of America have raised a fund for the erection of a bronze statue to the memory of Samuel D. Gross, doctor of medicine, doctor of laws, doctor of civil law, late professor of surgery in the Jefferson Medical College of Philadelphia, whose labors in the cause of his profession as surgeon and as author have caused his name to be respected in the civilized world as one of the benefactors of his race and have added luster to the entire medical profession of the United States: Therefore, be it

Samuel D. Gross, M. D., etc. Permission to erect statue of, in Washington.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That permission be, and the same is hereby, granted to the American Surgical Association and the Alumni Association of the Jefferson Medical College to erect said statue in such place in the city of Washington, District of Columbia, as shall be designated by the Superintendent of Public Buildings and Grounds. And the sum of fifteen hundred dollars, or so much thereof as may be necessary, is hereby appropri-

Appropriation for pedestal.

ated, out of any money in the Treasury not otherwise appropriated, for the erection of a pedestal upon which to place the said statue.

Approved, March 2, 1895.

March 2, 1895.

[No. 26.] Joint Resolution To extend the time for taking testimony in relation to the value of the improvements of the Monongahela Navigation Company on the Monongahela River in Pennsylvania.

Monongahela River, Pa.

Resolved by the Senate and House of Representatives of the United States of America in Congress assembled, That the time for taking testimony as to the value of the improvements of the Monongahela Navigation Company on the Monongahela River in Pennsylvania and the commercial importance of the free navigation of said river, directed to be taken by the Secretary of War under the River and Harbor Act of August seventeenth, eighteen hundred and ninety-four, be, and the same is hereby, extended to the thirtieth day of September, eighteen hundred and ninety-five, and the Secretary of War shall report to Congress thereon at its next regular session in December next, to the end that Congress may determine as to the expediency of making the navigation of said river free from tolls: *Provided*, That the expense of taking such testimony shall be paid for out of the appropriation for the improvement of the Monongahela River, contained in the act aforesaid.

Time for report on value of dams, etc., extended.

Laws, 2d sess. 53d Cong., p. 348.

Proviso. Expenses.

Approved, March 2, 1895.

PRIVATE ACTS.

January 17, 1895.

CHAP. 32.—An Act For the relief of I. H. Hathaway and Company.

Preamble.

Whereas it appears that Thomas H. Handbury, major, Corps of Engineers, United States Army, did, on the fourteenth day of June, eighteen hundred and ninety-four, issue a check, numbered two hundred and sixty-nine thousand seven hundred and ninety-eight, for ten thousand one hundred and fifteen dollars and thirty-four cents, on the assistant treasurer of the United States at New York in favor of I. H. Hathaway and Company, in payment of contract work done at mouth of Saint Johns River, Florida, which check is alleged to have been lost in transmission through the United States mails between Saint Augustine, Florida, and Philadelphia, Pennsylvania; and

Vol. 23, p. 306.

R. S., sec. 3646, p. 717.

Whereas the provisions of the Act of February sixteenth, eighteen hundred and eighty-five, amending section thirty-six hundred and forty-six, Revised Statutes of the United States, authorizing United States disbursing officers and agents to issue duplicates of lost checks, apply only to checks drawn to two thousand five hundred dollars or less: Therefore,

I. H. Hathaway. Duplicate check to be issued to.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the said Thomas H. Handbury. major, Corps of Engineers.

United States Army, be, and he is hereby, instructed to issue a duplicate of said original check, under such regulations in regard to its issue and payment as have been prescribed by the Secretary of the Treasury for the issue of duplicate checks under the provisions of section thirty-six hundred and forty-six, Revised Statutes of the United States. R. S., sec. 3646, p. 717.

Approved, January 17, 1895.

CHAP. 51.—An Act Authorizing the sale of title of United States to a tract of land in Montgomery County, in the State of Maryland, to William H. and George Bobinger. January 26, 1895.

Preamble.

Whereas William H. Bobinger and George Bobinger, of Montgomery County, Maryland, have been in the peaceable and uninterrupted possession of the tract of land in said county and State, hereinafter described by metes and bounds, for a period of fifteen years, under a claim of title and a bona fide belief that the same was indefeasible and in them, and under that belief have made valuable improvements thereon; and

Whereas under recent surveys ordered by the chief engineer of Washington Aqueduct it has been discovered that title thereto is in the United States: Now, therefore,

William H. and George Bobinger.

Sale of lands in Montgomery County, Md., to.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Secretary of War be, and is hereby, authorized and required to sell, grant, and convey unto William H. Bobinger and George Bobinger, of Montgomery County, in the State of Maryland, all the right, title, and interest of the United States in and unto all that tract of land in said county and State hereinafter described, at a price to be determined by the Secretary of War upon a consideration of all the circumstances of the case, which price shall be exclusive of the value of the improvements on said land: *Provided*, That the Secretary of War shall be of the opinion that the said sale will in no wise be detrimental to the Washington Aqueduct: *Provided*, That the encroachment thereon was not fraudulent and that the said Bobingers are the bona fide proprietors of the said adjacent land on which said hotel is built:

Provisos.
Protection of Washington aqueduct.

Bona fide occupation.

Description.

Beginning at a point south eighty-five degrees twenty-one minutes west, seventy-six and one-half feet from a stone marked "W. A. N. 43," and running thence north four degrees thirty-nine minutes west forty-seven feet; thence south eighty-five degrees twenty-one minutes west and parallel with the southern boundary of the United States land next west of Cabin John Bridge one hundred and eleven feet; thence south four degrees thirty-nine minutes east forty-seven feet; then north eighty-five degrees twenty-one minutes east one hundred and eleven feet to the place of beginning, containing five thousand two hundred and seventeen square feet, or about one-eighth of an acre of land.

Approved, January 26, 1895.

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